

[1st Lecture, University,
1876.]

Enthusiasm for Subject -

General interest increasing - outside
as well as within med. profession.

Some Disadvant. as well as advantages
of instruction -

1. much physical & repeat
2. Hard to illustrate
but everywhere illustrated -
3. many things seem abstract -

Met much bleeding & erroneous
teaching, which needs correction, &
place built on scientific basis -

What is health?

1. blood count, - 2. Food - 3. Air - 4. Exercise
5. Exercise - 6. also injur. viol. exposures

1860
1861
1862
1863
1864
1865
1866
1867
1868
1869
1870
1871
1872
1873
1874
1875
1876
1877
1878
1879
1880
1881
1882
1883
1884
1885
1886
1887
1888
1889
1890
1891
1892
1893
1894
1895
1896
1897
1898
1899
1900

1901
1902
1903
1904
1905
1906
1907
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000

Hygiene.

As a science, both abstract & practically applied,
increasing in extent & importance with
every year.

Based upon Physiology
and Sanitary Experience.

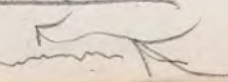
Divisions:

Personal, (domestic), Public Hygiene.

Personal, physiologically subdivided:

1. Alimentation - Food, Drink, Stimulants & Narcotics.
2. Respiration - Atmosphere; with which other subjects,
3. Circulation, as influence of Heat, Light, Seasons & Climate may be considered.
4. Excretion.
5. Reproduction: Sexual Hygiene.
6. Muscular Hygiene; that of Exercise & Labor.
7. Cerebro Nervous, i.e. Chiefly Mental Hygiene.

Also certain general topics are important
and common to both Personal & Public Sanitary Science.
viz. Etiology & Vital Statistics.

What is Health? 

Hyg. of Ships,
Encampments &
Hospitals, (military), (naval), (naval)
Hygiene.

D. A. Smith (1)

CO₂, Manchester
average 28 exp.

Inwood 7.6 parts

3 times 10, 11, 15 pl

Le Sanson

Lakeview
mean 4.39

Mine, Paris
mean 2.3

Vogel, Munich
mean 3 to 4

Roscoe, London 3.7

Levy, Atlanta 4.7

av. 11 exp.

over

Roscoe, London (2)

School room

floor 29.5

Ceiling 27.0

Pettenkoffer, Munich

School room 72

Bear Saloon 44

Luna, Madrid

Opera Hospital 43

Bed room 48

~~Lebanon, Paris~~

~~Dumas' study room~~

after lecture 67.4

Lebanon Hot House

morning 0.65

evening 0.00

nearly the temperature of the outer glass in which the blackened thermometer is enclosed), we have not indeed an absolute measure of solar intensity; for all measures of that must, it would seem, depend on the substance exposed and the conditions as to cooling, &c., under which the exposure takes place, but a sensitive test by which slight variations in its amount can be determined, and the amount at different places and different times compared.

F. W. STOW

The Aurora of February 4

THE following is an account of the aurora of February 4 as seen by a gentleman living in Russia, at Anspatti, in the province of Vitebsk. After stating that the barometer had risen very high (30.2), he says:—"To-night, as I drove home from Reugarten, there was the most beautiful aurora borealis I ever saw. It began in the north-west, and gradually rose higher and higher, till at last it reached the horizon a little north of east, and such a broad band, or rather succession of bands, that it covered half the heavens. It was a bright rose colour, and its light and colour were reflected by the snow, so that the whole earth was rosy; though it was between nine and ten o'clock, and there was no moon, it was nearly as light as day. It is still in full force as I am writing, and I can see it from my window, but it constantly changes its form and colour." I think the latitude of the place is 56 or 57.

J. M. H.

Aurora Island

NATURE for May 25 (which has only just reached this part of the world) contains a note respecting the reported disappearance of Aurora Island in the New Hebrides. In that note the small upraised coral island of that name north-east of Tahiti is confounded with Aurora—a high volcanic island—more than 40° to the west of the former. It is scarcely to be wondered at that the mistake should be made when the name of the island is alone given; but when "Aurora Island, one of the New Hebrides group," is spoken of as being to the "north-eastward" of the well-known island of Tahiti one feels surprised at the misconception.

Has it yet been clearly defined to which Aurora the report refers, and is it not more probable that the captain's chronometer was out, or that his reckoning was incorrect, than that either island has really been submerged? A few months ago Dr. George Bennett, F.L.S., of Sydney, New South Wales, showed me a sketch which he made of Aurora in the New Hebrides some years ago. From that the island appears very mountainous, and the map of Melanesia, in Petermann's Geographische Mittheilungen (1870), makes it about twenty miles long and 2,000 ft. high.

S. J. WHITMEE

Samoa, South Pacific, Nov. 4, 1871

P.S.—The following notes of earthquakes in the Samoa group may be of interest to some of your readers:—

May 14, 1871.—2.5 P.M. First a vertical, followed by a horizontal, shock.

July 1, " —9.30 A.M. Slight horizontal shock.

" 16, " —12.10 P.M. Vertical shock.

Aug. 3, " —12.15 P.M. Slight horizontal shock, accompanied by a loud rumbling noise.

Sept. 23, " —6.45 A.M. A slight horizontal shock.

I was absent from Samoa from September 1870 to April 1871. During that time there were eight shocks of earthquake in the group; but the dates and other particulars were not noted. One is reported as having been the most severe shock known here. Earthquakes have been more frequent in Samoa for the past year or two than formerly.

FOUL AIR IN MINES AND HOW TO LIVE IN IT

I.

I BEG to forward you for publication in NATURE an account of some very interesting experiments recently made at Chatham, on the employment of a respirator in military mining. They were conducted in a

thoroughly practical manner by Mr. J. Edward Gibbs, a highly intelligent young officer of Engineers, who, I may add, has given the respirator a very convenient form, and, I trust, will continue the work he has so well begun.

It is to be borne in mind that the cotton wool employed in the respirator is not to be steeped in glycerine, but moistened with this substance; the wool ought to be well teased until all its fibres are wetted, but they must not form a clot.

JOHN TYNDALL

"When on duty at the Defensive Mines one day during the mining operations of July and August 1871, three men were brought out in a fainting state, caused by a rush of foul air in untamping. Thinking some means might be devised for preventing such accidents, and the consequent loss of time and panic, I consulted with Captain Malcolm, R.E., who proposed Prof. Tyndall's firemen's respirator for consideration. Colonel Lennox sent me to the maker to inquire, and I returned with one.

"With the assistance of Quartermaster-Sergeant Ingram of the Chemical Laboratory, and several books of reference, I have collected the following notes:—

"After exploding a charge of gunpowder at a gallery-head, it becomes dangerous to untamp, because of the poisonous gases produced by the combustion of the powder. These gases are CO₂, N, CO, HS, C₂H₄, and H. The only gases that are present in sufficient quantities to harm are CO₂ and CO. CO₂ to the amount of $\frac{1}{200}$ (0.005) of the bulk of the air at the gallery-head would render it unfit to sustain life. CO to the amount of $\frac{1}{100}$ (0.01) would do the same. 100 lbs. of powder evolve 22559.38 cubic in. of gas at 60° F. and 30" B., of which 9429.7896 are CO₂, and 2249.848 are CO.

"Miners working in the presence of the foul air from the explosion suffer in two ways. If affected suddenly, they feel a burning at the nape of the neck, and their limbs tremble, they turn giddy and faint. This is to be attributed chiefly to the CO. The miners are also affected in a slower manner by the CO₂. They feel their breathing becoming difficult, as if there were a weight on their chest, with a tight feeling in the head; if not brought into the fresh air they are in time overcome and faint. This also brings on headache, on coming into fresh air.

"Any method of getting rid of the foul gases by chemical means must interfere greatly with the progress of the work. In any case there would be considerable difficulty in destroying the CO, as it has neither acid nor basic properties. A good system of ventilation through hose would clear the galleries of the foul air, but would not overcome the difficulty of untamping, because at any moment of the process there may be a rush of foul gas, which would take effect on the men at work, before the ventilation could carry it away.

"A good respirator worn by each of the men employed at untamping might overcome this difficulty. Prof. Tyndall's respirator for firemen is constructed with a view to enable the men to inhale pure air when at work in a burning house, by separating the smoke and noxious vapours. It consists of two parts; (1) the mouth-piece; (2) the body of the respirator.

"The mouth-piece is an invention of a Mr. Carrick, hotel-keeper at Glasgow, who had patented it.* It has two valves, *i* and *e*. (See NATURE, June 15, 1871.) The air inhaled comes from below, up through the body of the respirator and through *i*. The exhaled breath closes *i*, and escapes through *e*, thus keeping the contents of the body of the respirator cool. There is an aperture *o*, which fits closely round the lips, and to prevent respiration through the nose, there is a nose-pad fixed on top of the mouth-piece. A wire-gauze partition separates the mouth-piece from the contents of the body of the respirator.

* This is not the mouth-piece now adopted.—J. T.

"The body of the respirator is about 4in. or 5in. long, and contains at the top a layer of cotton wool, moistened with glycerine to prevent any solid particles escaping into the mouth from lower layers, and also to stop those very minute particles of the smoke that may not have been arrested below. Next comes a layer of dry cotton wool, then a layer of charcoal fragments, another layer of dry cotton wool, and then some fragments of slaked lime. Below this comes some more cotton wool, and then the wire-gauze cover or cap at the bottom.*

"For smoke the layer of lime is not necessary, but in the mines it would be of the greatest use, because it has a great attraction for CO_2 . The layer of charcoal would absorb the CO and the HS in the air, and the mixture inhaled would be perfectly innocuous. The disadvantages of this respirator in its present form for mining purposes are—that it is too long, and an effort is required in breathing through the small valves.† Mr. Ladd, of Beak Street, Regent Street, the maker of these respirators, has made some improvements in the mouth-piece, which may overcome some of the inconveniences of the old pattern.

"I received permission to use the R.E. workshops for experimenting on the shape best suited for use in the mines. Tyndall's respirator has been severely tested in dense and pungent smoke from pinewood, and it succeeded to the perfect satisfaction of Captain Shaw, Chief Officer of the London Fire Brigade. Firemen are to wear it attached to hide helmets, but for the mines any arrangement which will support the respirator and keep it close to the mouth during work, without being hot or uncomfortable, will suffice.

"*Experiments made with the Respirator.*—On Saturday, August 19, 1871, a trial of the respirator was made in the Chemical Laboratory, S.M.E., in the presence of Colonel Lennox, Dr. Fox, and others. I was shut up in an air-tight cupboard, with the respirator on. By my side were jars containing CO and CO_2 in a proportion of 1 to 200, each of the cubic content of the cupboard (141,698.4 cubic in.), not allowing for the space occupied by my own body and the stool on which I sat. The respirator contained animal charcoal and lumps of slaked lime mixed together, thus dispensing with one layer of cotton wool. After emptying all the jars, I remained for ten minutes in the full mixture (fifteen minutes in all) without the slightest discomfort except from the awkward shape of the respirator. I was then called out.

"On Monday, the 21st, another trial was made in the presence of Dr. Fox and Lieuts. Abney and Galwey. This time a rabbit and three birds were placed in the cupboard with me. The respirator contained, in addition to the charcoal and slaked lime, a small quantity of sulphate of soda. The only cotton wool used was a small layer soaked‡ in glycerine at the top, and a thin layer of dry wool at the bottom. The sulphate of soda was introduced according to Prof. Graham's advice, in order to give an atom of O to the CO to form CO_2 , becoming itself sulphite of soda. The content of the cupboard is 141,698.4 cubic in.: from this would have to be deducted the space taken up by my body, say $3\frac{1}{2}$ cubic ft. (Dr. Parke's Hygiene), or, roughly, 6,000 cubic in., leaving 135,698 cubic in. 1,890 cubic in. of CO_2 in jars were introduced from a pressure bag, making altogether:—

1,890 cubic in. of CO_2
1,921 cubic in. of CO,

or 3,811 cubic in. of poisonous gases in addition to my exhaled breath, or about 3 per cent. of the capacity of the cupboard. In order to perfect the mixture of the gases, I waved a towel about constantly, and after the end of

the trial, a taper being extinguished at the top of the cupboard showed that the CO_2 had been stirred up to the top. The rabbit and two birds died at the same time, about twenty-three minutes after the cupboard was closed, while the CO from the pressure bag was being introduced. I stayed in the cupboard thirty minutes (five minutes after the mixture was completed and seven minutes after the death of the animals). When I came out I felt a pressure on my ears, as when descending too rapidly in diving. Dr. Fox said that this was produced by my blood, my heart then beating at a high rate.

"This is satisfactory, as showing that the gases had not affected me, but only the exertion of breathing through the respirator, for thirty minutes, combined with the heat of the close atmosphere in which I was.

"To prove that the gases did not affect me, I quote some extracts from Dr. Parke's 'Hygiene':—"Dr. Angus Smith says the breathing of CO_2 to the extent of 1.5 to 2 per cent. produces slowness of heart action, while the respirations become quickened if not gasping; this is perceptible with as little as 1 per cent. Less than $\frac{1}{2}$ per cent. of CO has produced poisonous symptoms, and more than 1 per cent. is rapidly fatal to animals. CO in excess produces loss of consciousness, slowness of heart action, and finally paralysis of the heart.

"The slowness of diffusion of the two gases was remarkably shown by the effect on the third bird. The cage which held it was suspended at the top of the cupboard. The bottom, back, and top were of wood, the other sides were of wood for about $1\frac{1}{2}$ in. and then of wire. The bird, which was at first on a perch, was very soon affected by the impure air, and fell to the bottom of the cage. Here the wooden bottom and sides evidently supported a layer of pure air, for although the bird had lost consciousness, and indeed was considered to be dead, yet after being brought out into fresh air, it was revived by ammonia, and after an hour or so fluttered away. The other animals, that were not so protected, died before all the gases had been introduced.

"On examining the sulphate of soda, very little was found to have been changed into the sulphite; it would, therefore, seem that a constant change occurred, the sulphate giving up oxygen to the CO, becoming sulphite, and then the sulphite taking oxygen from the air to form the sulphate. Whether the good effect of the first change compensates for the loss of free oxygen in the second change is a question for the opinion of a chemist; however, Prof. Graham's recommendation is of great weight.

"All that were present agreed that the trial was perfectly satisfactory, and I think this is a fair conclusion. For the object in view throughout has been to devise some plan by which a man may work for some time in a foul mine, and may be secure from the effects of a rush of foul gas caused in untamping, &c.

"Defensive mines, though small, poison the ground more effectively than overcharged mines, which allow most of the gas to escape. I have before shown the total amount of CO and CO_2 evolved by the explosion of 100 lbs. of powder, which, according to our late operations, seems to be an average charge. It is probable that a large proportion of these gases would escape into the air, and that the rest would be diffused equally all round the charge. Therefore only a small amount is likely to be encountered at any one point. Hence it would seem that the respirator, which has succeeded with very powerful mixtures of poisoned air, would be quite enough to guard the miners from any of the gases from explosions.

"It only remains now to hit upon a convenient shape which will not render the breathing laborious. If we succeed in this, it is likely that the respirator would be of use also in civil work, such as exploring mines in search of bodies after a colliery accident."

J. E. G.

* This order may be varied in different ways without prejudice to the respirator.

† These objections have been in great part met by the recent forms of the respirator.

‡ See remark in the introduction above.

* This is one of the purposes contemplated by myself, but the suggestion of Mr. Gibbs is independent and original.—J. T.

Mr. P. 15 7/11 1871

July 24, 1875]

MEDIC

bag of about the size and shape of a half-barrel, and containing twenty-five gallons of air, which is worn upon the back ; being held in position by two straps encircling the arms. Two flexible tubes pass from the bag and terminate in a mouth-piece, and the nose is closed by a clasp, while the eyes are covered with glass protectors. A large pine box having been set up and filled with a dense cloud of smoke, three young men, wearing the apparatus, entered successively, and remained in it fifteen, eighteen, and twenty minutes respectively. They were in excellent condition when they came out, the only change in their appearance being a considerable redness of the face. The air in the bag is said to be sufficient for thirty minutes' respiration, and it is claimed that many lives can be saved by firemen being thus enabled to reach every room of the largest tenement-house (no matter how dense the smoke) and remove the inmates. One of the commissioners and a number of the engineers of the Fire Department were present, and expressed themselves as highly delighted with the success of the experiment.

pushed, perhaps without our knowledge, to a dangerous extent. The symptom alluded to, of impaired and distorted vision, was a significant one. He had observed it in a case which had been a very instructive one to him from the long-continued persistence in the use of the remedy. The case was one of spinal irritation, so called, complicated with severe lateral curvature, in an unmarried lady. He had exhibited five grains of chloral in her case the night before starting on a voyage to a Southern port. This was a portion of the first specimen imported by Messrs. Wyeth. Its effects were so happy that he authorized her continuance of it, under careful restrictions. It enabled her to get through the voyage in comparative comfort; and the relief which it gave her was so great that she ventured to give the same dose to other persons suffering from painful affections in the house where she was passing the winter, and was thus the means of introducing chloral into Florida.

Being at a distance, and being compelled to rely upon her own observation, she found, after a time, that its uninterrupted use produced smarting of the conjunctivæ, a symptom which was relieved by its suspension for a few days.

On watching her closely after her return, he was able frequently to verify this fact, and also further noticed that it was sometimes accompanied by a diminution of vision. Another symptom which he

Some little time since, an exhibition was given in the City Hall Park of what is known as Galibert's Respiring Apparatus, designed to preserve life amid smoke or foul air of any kind. It consists of a canvas

52.83
M. M. 1

of a planing-machine, and when admitted to the hospital it was simply hanging by a shred. In such cases it is always best to amputate some distance above the seat of injury, on account of the bruising of the mus-

results are said to be permanent, but this greatly depends on the patient, who must occasionally make use of the means which were first used to cure him.

TESTING THE PURITY OF AIR (*Dublin Journal of Medical Science*, Nov. 1872).—Dr. R. Angus Smith has devised a simple form of apparatus by which any person of ordinary intelligence and education might readily determine whether or not the amount of carbonic acid in the air of a place was above the normal or any other proportion. Baryta-water is a most sensitive re-agent for the detection and precipitation of carbonic acid. If half an ounce of baryta-water, containing about 0.08 gramme of baryta, be placed in a clear glass bottle having a capacity of 640 cubic centimetres (22 ounces), and the latter be well shaken, a turbidity (produced by a precipitation of barium carbonate) will be observed, if the proportion of carbonic acid in the air be 0.04 per cent.,—that is to say, the 0.2515 cubic centimetres of carbonic acid contained in the bottle will unite with the barium of the baryta-water, and form 0.00224 gramme of insoluble barium carbonate in half an ounce of water. The precipitate obtained renders the liquid turbid, but not quite opaque; it may be described as translucent. If a bottle of the capacity of 154 cubic centimetres (5.42 ounces) be employed instead of one of 640 cubic centimetres, no turbidity is produced in the baryta-water; on the other hand, if the bottle contain 44 ounces, or the air 0.08 of carbonic acid, the precipitate is twice as abundant. It is easy, then, by making an experiment in the pure open air, to observe the density of the turbidity caused by shaking half an ounce of baryta-water in a closed bottle or jar of 22 ounces capacity; and if, on repeating the experiment in a room, the turbidity is increased, then it is to be concluded that the

Testing Air

The same author (*Fres. Zeitsch.*, 1872, ii. p. 150) states that he has separated from the blood two new coloring-matters. One is soluble in alcohol and water, difficultly soluble in ether, and forms, when dry, a dark greenish-brown mass which chars without puffing up, and, after ignition, leaves a residue, consisting of oxide of iron, phosphoric acid, and silica. It is precipitated from its solution in water by acids, and the application of Teichmann's test does not yield hæmin-crystals. The other pigment separates in the form of dark bluish-black microscopic crystals, reminding one of indigo. These crystals are insoluble in water, alcohol, ether, chloroform, and acids, but are soluble in alkalis with the production of a dark-brown solution. If precipitated from the alkaline solution by acetic acid, and the precipitate subjected to Teichmann's test, the result is the most beautiful hæmin-crystals. Concentrated sulphuric and nitric acids dissolve this pigment with a greenish-yellow color, concentrated hydrochloric acid and aqua regia decompose it, and glacial acetic acid is without action upon it, unless ammoniac chloride has been previously added, in which case it dissolves it, forming a dark-brown solution which, upon evaporation, yields large pure hæmin-crystals. After ignition, the residue consists of pure oxide of iron. These crystals he considers to be identical with Virchow's hæmatoidin. An elementary analysis of these pigments is promised.

THE CURE OF STAMMERING (*N. Y. Medical Record*, Jan. 1).—The mode of treatment followed by M. Chervin, of Lyons, in this affection, has lately been the subject of investigation by a commission appointed by the Department Council. The commissioners state

Teichmann's test

carbonic acid is in excess and the air impure. Any medical officer of health or hospital physician might, by the aid of a few clear glass bottles of different sizes and a supply of baryta-water (lime-water might be substituted for baryta-water), easily ascertain the proportion of carbonic acid in the atmosphere of the places under his charge. A little practice would soon enable him to discriminate between the precipitate given by 0.04 and 0.08 per cent. of carbonic acid in the air. As houses practically never have as pure air as the tops of mountains, we may rest satisfied when a bottle of 3.78 ounces avoirdupois capacity gives no precipitate when half an ounce of baryta-water is shaken up in it. The air under such circumstances may contain 0.06, but cannot include 0.07, per cent. of carbonic acid. If lime-water be used, then half an ounce of it (containing 0.0195 gramme of lime) is to be shaken up in a 10½-ounce bottle, and it will remain clear if the carbonic acid be below 0.07 per cent.

Jan. 18, 1873]

MEDICAL

to weaken the theory, if one did not know that very young and in consequence soft bones are under the general law of growth of soft tissues, of which the development is interstitial. A more considerable divergence of the osteoplasts in adult bones has also been made an objection to the theory of peripheric growth; but the researches of Ranvier have demonstrated the variableness of these elements, and in consequence their utter uselessness in this question. When the cartilage of conjugation is removed, the growth of the bone is stopped, or at least diminished. Interstitial growth is observed occasionally in certain birds, and in some mammals; but in this last case the anomaly explains itself, because the bone, softened by inflammation, has taken the properties of the soft tissues. Moreover, this growth is never more than a very small fraction of the length of the bone which is the seat of it. Passing from the normal to the pathological growth of bone, M. Ollier remarked that since 1867 he has shown that irritation of the diaphyses of a long bone provokes the

Simoon or Simoon or Samiel
(miasma poison)

Blows at period of equinoxes,
on borders of Arabia, near Mecca
on Euphrates & in Persia - fatal
to animal life. Comes over burning
deserts of sand - eastern horizon sud-
denly dark yellow - thick sulphu-
reous exhalation from the ground, in
ascending spirations - Hissing &
crackling sound, hot current of
air - Beasts huddle - a caravan
imitate camels in bending heads to
earth (Camels bury nose & mouth in
sand). Lie immovable with face to earth,
passer over in $\frac{1}{2}$ hour at most. Safe in
a stream. Bodies dyed in it smell &
soon putrefy. Fine dust in it, penetrates
everything. Electrical?

Sirocco - Italian, S.E. wind, in
Spring - transmarine Simoon?
hot & relaxing depression -

Dry Winds -

Harmattan - periodical,
from interior Africa towards
Atlantic ⁱⁿ Dec, Jan & Feb,
gently with haze conceals Sun
for days - Extremely dry - no
dew during its continuance, sometimes frost,
veg. withers, grass becomes at once
like hay. Human skin peels
off. ~~but it checks infection,~~
~~it cures cutan diseases.~~

Khamseen - S.W., 3 or 4 days,
between July 15 & Aug. 15, Egypt
Arabia & Pers. ^{of those} ~~Surprised by it and~~
yellow - very hot & dry - lungs
compressed, breath difficult, skin dry,
body appears as if consumed by fire,
if they die - & dry up - not putrefy.

over -

ctions of our Southern States is much greater than is usually believed. I speak from an experience of six years passed mainly under the poisonous influence of malaria in the swamps of Louisiana and the exhausting heats of the lower Rio Grande. The deleterious action of malaria on the health is well understood and universally acknowledged by competent observers in this country; but the masses, while they recognize its hurtful nature, are scarcely aware of the destructive ravages it is capable of working in a comparatively short time, and that notwithstanding the adoption of precautionary measures. It is not, however, my intention to enlarge upon this point. The subject is well and fully represented in the writings of others. As premised, what I desire to show is the slower but not less sure deterioration wrought upon the constitutions of northern born people by the *pure unadulterated heat* of a hot climate, *free* from malaria, basing my remarks largely upon the results of personal experience and observation in the basin of the lower Rio Grande. During my stay in that section there must have been a remarkably small evolution of malaria, as I perceived none of its characteristic effects upon the troops; neither were the conditions favorable to its production. The soil is sandy and alkaline, and supports a scant vegetation, stunted mezquite (*algarobia glandulosa*) and cactus (*opuntia*) constituting the main growth. The rain-fall was confined chiefly to the autumn months, the meteorological register at Ringgold Barracks showing the annual fall to have amounted to about ten inches. The habit among the Mexicans of turning their beef in the open air showed that there was but a trifling amount of atmospheric moisture, and that desiccation rather than putrefaction of animal and vegetable substances took place. The agent above all others which tended to the production of disease was the excessive heat, and it performed its work in an insidious manner, but ultimately sufficiently evident to any not wilfully blind. The register at Ringgold Barracks showed the mean annual temperature at that point to be about 76° Fahr., only one degree cooler than that of Vera Cruz, and only 3° cooler than that of some places in the vicinity of the equator. The mean temperature of the spring months at Ringgold Barracks was about the same as that of the same season at Havana, but the summers were 5° hotter than those of the latter place. At Singapore, Malacca, under the equator (nearly) the mercury never rises higher than 85°. At Ringgold Barracks it was not a rarity to see it 25° higher than that, or 110° in the shade. That post is situated between the isothermal lines of 70° and 80°, corresponding to the central portion of Egypt.

The actual temperature to which persons are exposed is not accurately represented by a thermometer placed in the shade and screened from solar reflections. Many terrestrial and atmospheric conditions combine to affect the bodily temperature without materially affecting that represented by the thermometer. Some such were in operation at Ringgold Barracks. As is well known, heat is absorbed in different amounts by different soils. Sand containing lime possesses the greatest absorbing power. Herschel observed the temperature of the sand at the Cape of Good Hope to be no less than 159° Fahr. At Ringgold Barracks a thermometer recording over 140° Fahr. was exposed to the sun in the angle of a light-colored building where the reflection was considerable, and left for a few minutes. The mercurial column ran rapidly to the end of the tube, and meeting with resistance burst the bulb. The soil in the vicinity of Ringgold Barracks is composed chiefly of sand containing lime in con-

Hygiene — Temperature

Capt. Simpson

P. H. Murray

M. S. A.

Rec'd, July 1875

1875

siderable quantity. In color it is light, and the reflection of the hot as well as the light rays of the sun greatest from such soils. Hot winds, comparable to the simooms of Arabia, occasionally blew during the summer, generated by the extreme heat of the parched plains of Mexico. That Ringgold Barracks is situated in one of the hottest parts of our country is sufficiently evident from the meteorological register kept at the post, a short synopsis of which for the years 1871 and 1873 I give below:

1871.	Mean temp. in the shade.	Maximum in the shade.	Minimum in the shade.
Spring	78.45°	109°	42°
Summer ...	88.88	105	72
Autumn ...	74.57	99	42
Winter	60.86	92	32
1873.			
Spring	75.06	106	30
Summer ...	86.64	105	65
Autumn ...	73.66	99	32
Winter....	61.69	94	20 unusually low

The mean maximum temperature for July, 1871, around numbers was 102°! Can such an elevated temperature act otherwise than injuriously upon the race of the north?

It is not considered essential to the object in view to cite special cases. This could be easily done if deemed necessary; but a statement in general terms covering the field of my observation will, it is believed, meet the necessary requirements.

The question of diet is one of great importance in its bearing upon the health of persons from the North living on the lower Texan frontier. The system manifests a natural craving for a dietary in accordance with the temperature in which an individual is placed provided the appetite is unperverted. In countries where nature furnishes a superabundance of heat the calorific articles of aliment are undoubtedly hurtful, and cooling fruits and vegetables the natural food of man. At Ringgold Barracks, inferior melons during the summer and oranges during the winter were practically the only fruits obtainable. Fresh vegetables were extremely scarce, while meat was furnished at low rates and in superabundance. Hence the diet may be looked upon as coöperating somewhat with the climatic influences, but to what extent I am unable to say. The natives themselves, living on a very simple diet, are in the main dwarfed in stature, and not noted for longevity. Few specimens of hale old age were met with among them.

The most noticeable effect that I observed produced upon the systems of strangers by the excessive and prolonged heat was simple general debility, weakening of the bodily functions, marked by a diminution of the assimilative and digestive powers and resulting in the loss of weight, and anæmia. Iron and tonics constituted per force a large percentage of the medicine used in treating the sick. At one time during my stay a chalybeate preparation was needed and daily used by every lady in the garrison.

The sick report exhibited but little if any evidence of unusual unhealthfulness of the climate; for while the men were not subject to acute disorders, the evidence of a lowering of their physical standard was nevertheless noticeable in their general appearance. Although ostensibly absent, the enemy working insidiously at the foundations of health was really present in

HIGH AND LOW BAROMETER.—In a valuable paper, read before the American Academy of Sciences, at Washington, last week, Prof. Elias Loomis, of Yale College, said that, in a large majority—say two-thirds—of instances, if there is low barometer at a given point, high barometer is found at a locality to the southeast at a distance of about 1200 miles on this continent. Observations in Europe give the same result as to coincidence and direction, but the distance there is about 1700 miles. In both continents the high barometer is always associated with low temperature. Thus, when there is an area of low barometer in Alaska, there is one of high barometer, accompanied by cold, at about the middle of the United States; when there is low barometer in Iceland, there are records of high barometer and cold at Paris and Vienna. The physical connection between these areas of high and low barometer is a subject for hypothesis. In general there is a flow of air to the central portion of an area of low barometer; it seems necessary to assume that the air thus concentrating must rise and flow out above. On the other hand, it is shown that with an area of high barometer there is a steady flow of air outward; it would appear that this air must be descending from above within that area, and must be continuously supplied, as the outward flow does not send the barometer down. Now if within an area of low barometer the air is going up, and simultaneously within an area of high barometer is going down, it seems at least probable that the air which goes up in one comes down in the other. But it will not yet answer to assume that this may account for our cold spells, if we admit that the air which was cooled and went up in Alaska comes down upon New York, bearing, so to speak, its cold; for there is a law of compensation always at work. The capacity of air for heat depends upon its density; if carried to a height the air expands, and, pound for pound of air, there is the same amount of heat in it at all elevations. Prof. Henry said he was inclined to accept the theory, however, as partly explanatory of areas of cold; as we ascend, with rarity of air we find increasing chill, until, if we could be carried alive into celestial space above the limits of the atmosphere, we might experience a temperature of near 400 degrees below zero:

of gray marble, beneath which is a broad strip of orange colored Italian marble, with a sub-base of blue marble. The building is so near completed that one day's hard work would place it in excellent condition for the opening, and the various galleries are so nearly finished that in all but one the workmen can go forward with the hanging of pictures. In several of the galleries considerable progress has already been made in hanging.

The terra cotta group of America, executed at the Messrs. Doulton's Lambeth Potteries, England, and placed on a pedestal immediately beneath the dome in Memorial Hall, has been put in position and arranged in all its details. The group is a wonderful specimen of what can be accomplished in producing ornamental effects with very common material. The great size of the group rendered the firing of it very difficult, but such was the care exercised that the various sections were fired without a single crack or flaw.

The annexe to the Art Gallery is completed, and pictures are being hung in the galleries allotted to the United States, France, Italy, Brazil, Mexico, Belgium, the Netherlands, Sweden and Norway. In some of the galleries the hanging has been finished, and in these some idea may be formed, from the numerous beautiful paintings and statues on exhibition, of the character and scope of the Exhibition as a whole.

The Horticultural Department, Centennial Exhibition.—Horticultural Hall is entirely finished, and is in the hands of Mr. Charles H. Miller, Chief of the Bureau of Horticulture, who, together with his assistants, is busily engaged in placing the exhibits. These are now coming in very fast, and will, it is expected, all be in place by this evening. The interior of the building presents a very beautiful appearance. Large additions have been made to the collection of rare tropical plants under cover, and two collections of ornamental plants and plants of commerce have recently been received from Havana. Enough planting has been done to render the grounds highly attractive by the opening day, but it is impossible to do some of the planting until later in the season. Two of the summer houses, which have already been described, are completed, and a third is in course of erection.

In front of the eastern entrance to the

DIRECTIONS FOR HANDLING & PUTTING UP
WOODRUFF'S
PATENT PORTABLE BAROMETER.

To put up the Barometer.

Turn the Instrument on its side, the top being a little the lowest, then turn back the screw in the side of the cistern, near the base, about three-fourths of an inch, and slowly raise it to a perpendicular position without turning it over; then, by means of the plates at the top and bottom, fasten it with screws or nails against the wall or ceiling, as nearly plumb as possible. Remember that the accuracy of the Barometer depends upon its *not being handled while the screw is turned out*, and if you have occasion to move it or carry it about, first lay it down with the screw side up and the top end the lowest, and when the mercury has run into the tube, turn in the screw to its head, and you can then carry it anywhere with perfect safety.

Be sure and never turn the Instrument over when the screw is turned out.

It is well to jar the Instrument slightly before putting it up, taking it down, or before taking an observation.

If you observe these simple directions, you will never be troubled with its getting out of order.

What the Barometer Indicates.

A steady, gradual rise indicates fine, clear, settled weather—a steady Barometer, continued weather of the kind then prevailing. Rapid fluctuations, unsettled weather; and a very great and rapid rise, with the wind northeast, a *northeast storm*, which will come on with little or no fall in the Barometer. A very great and rapid fall indicates that the storm will be very soon, violent, and accompanied with wind, but of short duration; while a slow, gradual fall of two or three days duration, a long storm, which will continue till a few hours after the mercury begins to rise. A little observation will enable you to determine the mean, or medium height of the column, and although changes in the weather are indicated rather by the *rise and fall* of the mercury than by the *particular place* of it in the tube, yet it may safely be predicted, that when the mercury is below the mean and fair weather occurs, it will be of short duration; and so of foul weather occurring when the mercury is above the mean. The usual range will not exceed three or four tenths of an inch, but before violent gales it sometimes sinks an inch or more.

The range is greater in winter than in summer, and greatest in spring and autumn. The mercury is highest before and during slight northeast winds, and lowest when the wind is in the southwest. When the mercury is steady at one point, it denotes steady and continued weather of the kind then prevailing. Slight falls of snow or rain will sometimes occur when the mercury is above the mean and rising, which will be followed by fine, dry weather, especially in summer. The mercury usually begins to change about twenty-four hours before a change in the weather, but before sudden changes it will sometimes not be more than three or four hours; while previous to a long continued change it will sometimes commence to change very slowly, three days previous to a storm. The time that will elapse before a change in the weather, will be in proportion to the slow or quick action of the mercury.

When the top of the mercury is convex, or turned upward, the mercury is rising—expect fair weather. When it is concave, or turned down, it is falling—expect foul weather. When you wish to observe its movements, adjust the Index to the top of the mercury, and you can then note how much it varies in a given time.

AGENTS WANTED EVERYWHERE.

CHARLES WILDER, Peterboro', N. H.

Portable
Mercur. Barometer

PRICE SIXPENCE.

Don't copy

THE
ANEROID BAROMETER
HOW TO BUY AND HOW TO USE IT

WITH THE NEW ALTITUDE TABLES BY THE
ASTRONOMER ROYAL

"FOR CONSIDERING THE WEATHER."—*Shakspeare.*

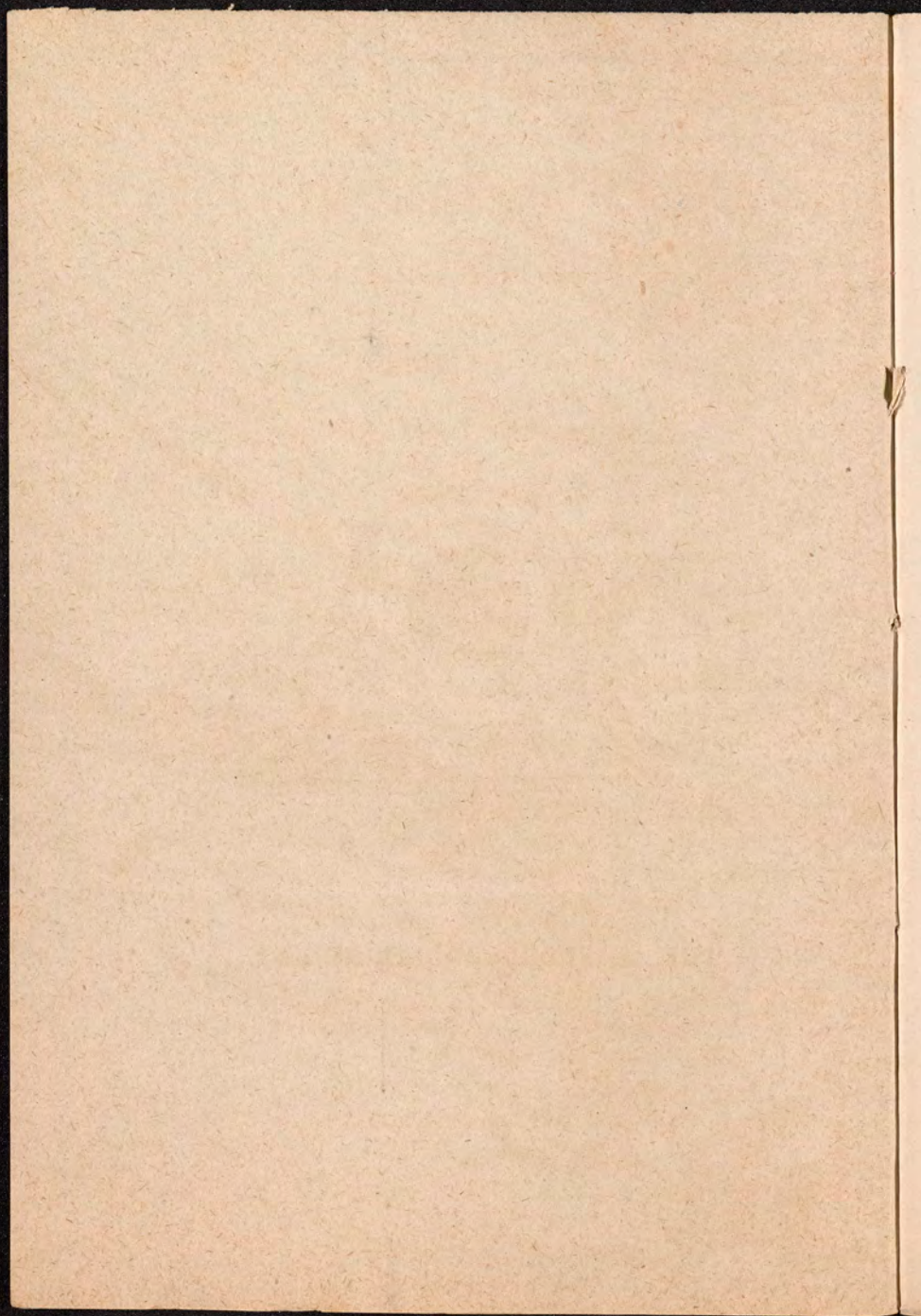


BY A FELLOW OF
THE METEOROLOGICAL SOCIETY

EIGHTH THOUSAND

LONDON
HOULSTON AND SONS
65, PATERNOSTER ROW

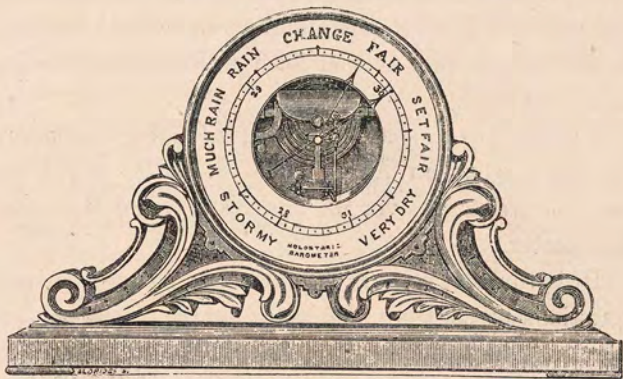
MDCCCLXXII.



THE
ANEROID BAROMETER

HOW TO BUY
AND
HOW TO USE IT

FOR CONSIDERING THE WEATHER."—*Shakspeare.*



EIGHTH THOUSAND

BY A FELLOW OF
THE METEOROLOGICAL SOCIETY

LONDON
HOULSTON AND SONS

65, PATERNOSTER ROW

MDCCLXXII.

P R E F A C E.

A GENERAL conviction that the personal comfort, if not safety, of every one may be promoted by a foreknowledge of the weather has developed a growing taste for such instruments as enable observers to foretell meteorological changes, and given a great impetus to the manufacture of that form of Barometer known as the Aneroid.

A desire has thus arisen among intending purchasers to know what an Aneroid Barometer is, and what are its advantages over the more established Mercurial Barometer.

It is the aim of this brief treatise to answer such questions by showing that, as a simple "weather indicator," the Aneroid Barometer is equal to, and in many respects superior to some of the varieties of Mercurial Barometer; that in its least expensive forms its appearance is elegant and compact, and that since the removal of the restrictions of the patent of Fontaine Moreau, the instrument is now produced in a much improved form, at such a price as to place it within the reach of all.

THE ANEROID BAROMETER.

It is interesting to know that "weather-glasses" were used even before the eighteenth century,—De Foe, the author of *Robinson Crusoe*, having registered their indications in his account of the great storm of 1703. Admiral Fitzroy, in his notice of this fact, says:—"It is an instance of the necessity for *repeating* information, that, generally speaking, even *now* so little complete use is made of these indicators, however inexpensive and even familiar they have become."

A few remarks tending to elucidate the principles of action in the Mercurial Barometer will materially assist the reader in comprehending the working of the Aneroid; and this will best be done by imagining ourselves at the bottom of an ocean of air, about forty-five miles deep, the surface of which suffers agitation and rolls in waves, as do the waves of the sea. It must not, however, be supposed that the fluctuations in the height of the mercurial column represent the height and depth of surface waves of air. "The barometer," says Admiral Fitzroy, in his *Barometer Manual*, "shows whether the air is getting lighter or heavier, or is remaining in the same state. The quicksilver falls as the air becomes lighter, rises as it becomes heavier, and remains at rest in the glass tube while

the air is unchanged in weight. Air presses on everything within about ten miles of the world's surface like a *much* lighter ocean, at the bottom of which we live—not feeling its weight, because our bodies are full of air, but feeling its currents, the winds. The weight of the air, or force of its pressure, is nearly fifteen pounds to the square inch; and the cause of the variations in its weight, as indicated by the oscillations of the barometer, is to be sought for, according to Müller, in the unequal and constantly varying distribution of *heat* over the earth's surface. As the distribution of heat constantly varies, the equilibrium is likewise disturbed at every moment, and currents of air arise, which strive to restore the balance. The air is thus in constant motion, sometimes more heated, and then lighter; and at other times more cooled, and consequently denser. As it contains sometimes more, sometimes less vapour, the pressure of the columns of air will also be exposed to continual changes, indicated by the barometer."

The practical end in view in using a barometer is to learn how to translate these indications in such a manner as to enable the observer to "foretell weather."

The Aneroid Barometer is admitted by the highest authorities to be fully equal to this object, and there can be no doubt that it is an instrument which, from the ingenuity displayed in its construction and the accuracy of its indications, is entitled to the highest confidence from the public; and it is hoped that the details herein set forth may aid in dissipating the doubts as to its efficiency which have been needlessly entertained, and thus raise the Aneroid Barometer to

that position in public estimation to which it is fully entitled.

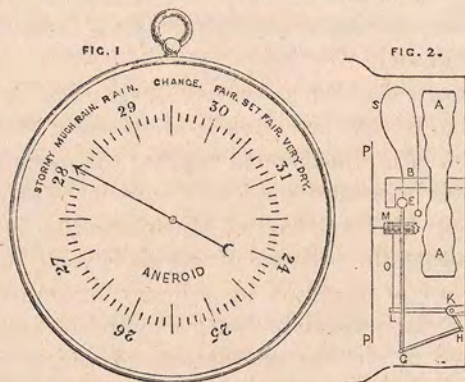
There is one feature in which this instrument possesses an advantage over all other forms of weather indicators, viz., its compact circular form, by which it recommends itself at once as a convenient companion for tourists for measuring the height of mountains. It has been made as small as a lady's watch, as large as a church clock, and of all intermediate diameters, being equally accurate in every size, possessing in some instances sufficient delicacy to indicate the variation of pressure between the height of an ordinary table and the ground.

The word aneroid is derived, in an anomalous way, from the Greek privative *a* and *neros*, wet. The invention of the instrument bearing the name Aneroid Barometer was attributed to Conté in 1798, and to Vidi about 1844, and excited much attention in 1848-9. By its means the pressure of the air is measured without the use of liquid as in ordinary instruments, the source of the indications being a cylindrical metal box exhausted of air, the undulations of which, resulting from the varying pressure of the atmosphere, are transmitted by delicate multiplying levers, to an index moving on a scale. By an increase of pressure the top is pressed inwards; and when, on the contrary, a diminution of pressure takes place, a movement in an opposite direction is the result.

A more detailed description, and a reference to the accompanying woodcut,* will render these general state-

* The woodcut and description are reproduced, by permission of the publishers, from Chambers's "Encyclopædia."

ments more readily comprehensible. The face of the Aneroid Barometer is represented in fig. 1. It has a diameter of about $4\frac{1}{2}$ inches; and the case behind, which contains the mechanism, a general idea of which is given in fig. 2, is about 2 inches deep. The pressure of the atmosphere acts on a circular metal box, A A, about 3 inches in diameter, and a quarter of an inch deep, which has been exhausted of air, and then soldered air-tight. The sides are corrugated in concentric rings, so as to increase their elasticity, and one of them is



fixed to the back of the brass case which contains the whole. The amount of exhaustion is such that if the sides of the bed-plate were allowed to take their natural position, they would be pressed in upon each other; and to prevent this they are kept distended to a certain extent by a strong spring, S, fixed to the case, which acts upon the head of the stalk B, attached to the side next the face. When the pressure of the air increases, there being little or no air inside the box

to resist it, the corrugated sides are forced inwards, and when it diminishes again, their elasticity restores them to their former place; and thus the little box becomes a spring extremely sensitive to the varying pressure of the external atmosphere.

Supposing the two sides pressed inwards, the end of the spring E will be drawn towards the back of the case, and carry with it the rod E G, which is firmly fixed into it. E G by the link G H acts on the bent lever, H K L, which has its axis at K, so that while the arm K H is pushed to the right, L K is moved downwards. By this motion a watch-chain, O, attached at L, is drawn off the little drum M, and the index hand P P, which is fixed to it, would move from the position represented in fig. 1 to one towards the right. When the contrary motion takes place, a hair spring moves the drum and the hand in the opposite way. By this mechanism, a very small motion of the corrugated sides produces a large deviation of the index hand; $\frac{1}{200}$ of an inch causing it to turn through 3 inches.

We have a no less important authority than that of the late Admiral Fitzroy for stating that "Aneroids are now made so portable that a pilot or chief boatman may carry one in his pocket, as a railway guard carries his timekeeper; and thus provided, pilots cruising for expected ships would be able to caution strangers arriving, if bad weather were impending, or give warning to coasters or fishing-boats."

The same authority says the Aneroid is quick in showing the variation of atmospheric pressure, and to the navigator who knows the difficulty, at times, of

using the barometer, this instrument is a great boon, for it can be placed anywhere quite out of harm's way, and is *not affected by the ship's motion*, although faithfully giving indication of increased or diminished pressure of air. In ascending or descending elevations, the hand of the Aneroid may be seen to move (like the hand of a watch), showing the height above the level of the sea, or the difference of level between places of comparison.

"The Aneroid is an excellent weather-glass, if well made. Compensation for heat or cold has lately been introduced by efficient mechanism. In its *improved* condition it is fit for measuring heights as far as 5,000* feet with approximate accuracy; but as a *weather-glass* only it is *exceedingly valuable*, because it can be carried anywhere; and if now and then compared with a good mercurial barometer it may be relied on sufficiently. I have had one in constant use for ten years, and it appears to be as good now as at first."

Colonel Sir Henry James, R.E., of the Ordnance Survey Department, has issued a series of *Instructions for taking Meteorological Observations*, and in speaking of the Aneroid Barometer he says:—"This is a most valuable instrument; it is extremely portable. I have had one in use for upwards of ten years, and find it to be the best form of barometer as a 'weather-glass' that has been made."

James Glaisher, Esq., F.R.S., the fame of whose

* Since this opinion was expressed by the late Admiral Fitzroy, Mountain Aneroids, fully compensated for temperature, have been made to yield reliable indications up to 16,000 feet.

balloon ascents is now almost world-wide, and one of whose objects in making balloon ascents was "to compare the readings of an Aneroid with those of a Mercurial Barometer up to five miles," says, "The Aneroid readings from all the observations made in the several ascents may be safely depended upon, and also that an Aneroid can be made to read correctly to pressures below twelve inches, and even to the first place, and probably to the second place of decimals."

Mr. J. H. Belville, of the Royal Observatory, Greenwich, in referring to results obtained from the Aneroid during a tour in Wales, says that "its movements were always consistent." "It was a delightful companion, and highly useful, its indications preventing many an excursion which would have ended in disappointment."

Captain Sir Leopold McClintock, in his account of his voyage in search of Sir John Franklin's party, states that atmospheric changes were indicated first by the Aneroid, then by the Sympiesometer, and lastly by the Mercurial Barometer, thus adding further valuable proof of the superior sensibility of the instrument now under consideration.

In considering the construction of the Aneroid, the source of the indications obtained by the motion of the needle on the dial will first claim attention. These arise from the pulsations or throbbings (so to speak) of the *vacuum chamber* B, which is composed of two discs of corrugated German silver, firmly soldered together, to each of which is firmly soldered a brass centre,—one with a thread on it, to screw the chamber

to the *base-plate A*; the other plain, with a hole drilled across it, to receive a *knife-edge C*, which suspends the vacuum chamber from a *powerful spring D*, as seen in the drawing. On these principally depends the action of the instrument. The *base or foundation plate A* is of iron or brass, and circular in form; to this the vacuum chamber previously described is firmly attached, while a strong *iron carriage E*, fixed across the chamber, supports the *main-spring D*, which, acting in direct opposition to the undulations of the

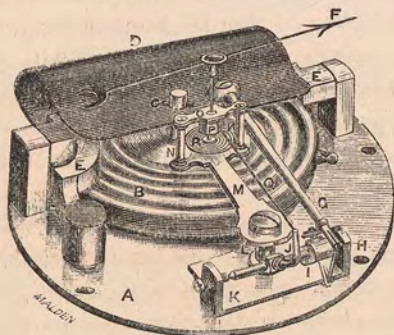


Fig. 3.

vacuum chamber B, give rise to the variations of the *needle F*, right and left on the *dial*.

The system of levers by which the slight undulations of the vacuum chamber are transmitted to the index needle will now receive attention.

To the *main-spring D* is attached the *main lever G*, a compound bar of steel and brass about two inches in length, which serves the double purpose of connecting the action of the vacuum chamber and spring to

the indicator, and of compensating for any error which might arise from sudden changes of temperature. To the end of this arm is attached a small *rod of steel* to connect it to the *regulator*, which is furnished at its centre with a *vertical arm* of brass, by which it communicates with the movement.

The movement is furnished with a stout *base-plate* K, of brass, the projecting ends of which are turned up at right angles with the bottom; to the centre of this base-plate a *short brass pillar* is screwed, bearing a *projecting arm* M, also of brass, at the end of which are *two smaller brass pillars* N, supporting a *thin plate of brass* O, between which and the flat arm works the *arbor* P, on which is fixed the hand. A piece of *fine chain* Q, such as is used in the delicate works of small watches, is attached to and works round the arbor P, and on the rise or fall of the levers, a *fine hair-spring* of coiled steel R, one end of which is attached to one of the pillars N, tends to keep the hand in its proper position.

The *regulator*, I, works between the bent-up ends of the base-plate, and supports a *vertical brass arm* J, to the upper end of which is attached the end of the *fine chain* which works round the arbor.

The connection having been made between these various parts, the entire movement is then screwed to the iron foundation-plate A, to which the vacuum chamber has been previously fixed; the multiplicity of levers in the "movement" is then connected with the main lever attached to the main-spring by means of a *fine steel rod* at the end of the main lever, and the communication being thus rendered complete between

the various parts of the instrument, it is ready for the final adjustment of the dial and hand.

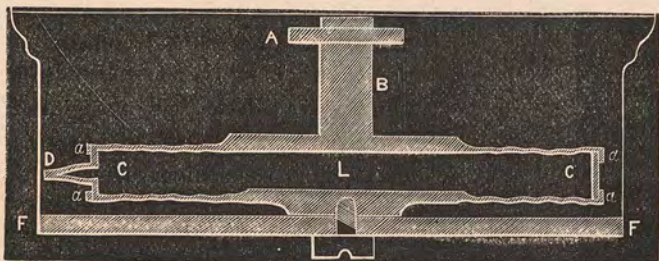


Fig. 4.

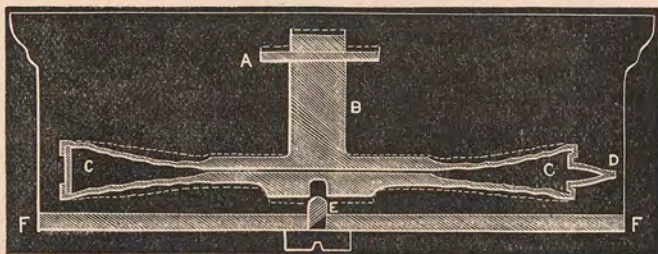


Fig. 5.

Figs. 4 and 5 are sections of the vacuum chamber, a perspective view of which *in situ* is shown at B, fig. 3, page 10. A is the V-shaped pin which rests on the main-spring (D, fig. 3), B is the socket in which it rests, and this is firmly soldered to the upper surface of the chamber C C, the lower side of which is as firmly attached to the base-plate. The overlapping of the thin corrugated German silver is shown at a a a a, while the tube through which the exhaustion is made is shown at D. Fig. 5 shows the result of exhausting

the air; this will not seem surprising when it is remembered that the external surface of an Aneroid of moderate dimensions sustains a pressure of between 50 and 60 lbs., and the state of tension to which it is brought when screwed up to the dotted lines, fig. 5, will enable the reader to understand its extreme readiness to pulsate with the varying pressure of the atmosphere.



Fig. 6.

The instrument being now screwed into its case, is next tested under the air-pump to ascertain its range, or the number of inches it will indicate to the circle, after which the dial is divided and engraved, and being placed in position, the needle is attached to the arbor, and the portion of the scale to which it should point is ascertained by reference to the scale of a Standard Mercurial Barometer, with which it is made

to agree *exactly* by a slight turn of the adjusting screw connected with the carriage which supports the main-spring.

In order to secure reliable indications from this extremely sensitive instrument, it is desirable that, like its associated aids to meteorological observation, it should be suspended or fixed in a place where sudden changes of temperature are not likely to occur. If this precaution be observed, the indications of a *compensated* instrument may be accepted as thoroughly reliable, notwithstanding the objections which have been urged against the variations of the Aneroid Barometer from the effect of temperature, since these seldom exceed a tenth of an inch in a range from 28° to 80°, to which extent a Mercurial Barometer would doubtless be affected under similar circumstances.

Compensation for temperature is effected by filing away half the thickness of the main lever or arm, and replacing the brass thus removed by an equal bulk of steel. This will be recognised at once as being the same in principle as the method adopted by Earnshaw in the construction of the compensating balance of chronometers. The importance of compensation, especially for Pocket or Mountain Aneroids will become apparent when it is remembered that the removal of an Aneroid from the dressing-table in the colder Alpine regions to the pocket will alter the temperature quite 30° F., and it has been found that a difference of 30° of temperature, without the compensating arrangement, raises the needle through one-tenth of a degree, while, with the same increment of heat, after the introduction of the steel, the hand remains stationary.

The circular form and varying diameter of the Aneroid Barometer offer great facilities for the exercise of artistic taste in the style of mounting them, and purchasers will naturally expect in this Manual some information under this head.

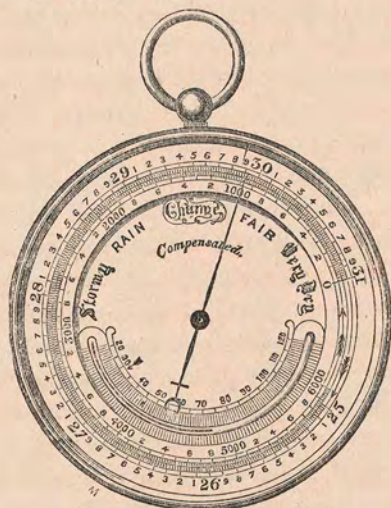


Fig. 7.

THE MOUNTAIN ANEROID.

"Up to the mountain's top, and mark."—*Shakspeare.*

This instrument may be purchased in the three diameters of $1\frac{1}{4}$, $1\frac{1}{2}$, and $1\frac{3}{4}$ inches, which may fairly be regarded as "Watch Aneroids;" and though an expensive mounting is by no means essential, they are supplied by opticians in silver shut-up cases, in every respect like a hunter's watch, and when graduated for heights, they form most convenient and useful companions for tourists. Nor is their usefulness necessarily confined to Alpine or highland tourists, since

advantage may be taken of the extreme sensibility possessed by the Aneroid, and already referred to (page 5), to estimate the difference of altitude between the place of business and the private residence of the owner, and other similar applications.

An instance indicative of the *correct* indications of a well-made Aneroid is worthy of mention as calculated to give confidence in the instrument to intending purchasers. A tourist in Egypt, ignorant of the height of the principal pyramid, ascended it "armed" with a pocket Aneroid, and noting its indications at the base and summit. On returning to his hotel, and consulting his guide-book, the height indicated by the Barometer was found to agree exactly with that obtained by trigonometrical survey and by the Mercurial Barometer.

In conducting scientific investigation and comparison it is of course necessary to exercise extreme accuracy; but for the purpose of the general tourist an approximation to correctness is all that is desired or aimed at, and this being the case, it cannot be regarded as otherwise than an advantage that the Mountain Aneroid requires no correction for temperature, and may be used with the following valuable tables for the determination of heights by means of the Aneroid Barometer recently furnished by Professor Airey, the Astronomer Royal, and by whose kind permission they are reproduced in this pamphlet.

AIREY'S TABLES.

Corresponding Numbers of Elevation in English Feet, and of Readings of Aneroid or Corrected Barometer in English Inches (the Mean of Atmospheric Temperatures being 50° Fahrenheit).

Height in Feet.	Aneroid or Corrected Barometer.	Height in Feet.	Aneroid or Corrected Barometer.	Height in Feet.	Aneroid or Corrected Barometer.
ft.	in.	ft.	in.	ft.	in.
0	31·000	2000	28·807	4000	26·769
50	30·943	2050	28·754	4050	26·720
100	30·886	2100	28·701	4100	26·671
150	30·830	2150	28·649	4150	26·622
200	30·773	2200	28·596	4200	26·573
250	30·717	2250	28·544	4250	26·524
300	30·661	2300	28·491	4300	26·476
350	30·604	2350	28·439	4350	26·427
400	30·548	2400	28·387	4400	26·379
450	30·492	2450	28·335	4450	26·330
500	30·436	2500	28·283	4500	26·282
550	30·381	2550	28·231	4550	26·234
600	30·325	2600	28·180	4600	26·186
650	30·269	2650	28·128	4650	26·138
700	30·214	2700	28·076	4700	26·090
750	30·159	2750	28·025	4750	26·042
800	30·103	2800	27·973	4800	25·994
850	30·048	2850	27·922	4850	25·947
900	29·993	2900	27·871	4900	25·899
950	29·938	2950	27·820	4950	25·852
1000	29·883	3000	27·769	5000	25·804
1050	29·828	3050	27·718	5050	25·757
1100	29·774	3100	27·667	5100	25·710
1150	29·719	3150	27·616	5150	25·663
1200	29·665	3200	27·566	5200	25·616
1250	29·610	3250	27·515	5250	25·569
1300	29·556	3300	27·465	5300	25·522
1350	29·502	3350	27·415	5350	25·475
1400	29·448	3400	27·364	5400	25·428
1450	29·394	3450	27·314	5450	25·382
1500	29·340	3500	27·264	5500	25·335
1550	29·286	3550	27·214	5550	25·289
1600	29·233	3600	27·164	5600	25·242
1650	29·179	3650	27·115	5650	25·196
1700	29·126	3700	27·065	5700	25·150
1750	29·072	3750	27·015	5750	25·104
1800	29·019	3800	26·966	5800	25·058
1850	28·966	3850	26·916	5850	25·012
1900	28·913	3900	26·867	5900	24·966
1950	28·860	3950	26·818	5950	24·920
2000	28·807	4000	26·769	6000	24·875

THE ANEROID BAROMETER.

Height in Feet.	Aneroid or Corrected Barometer.	Height in Feet.	Aneroid or Corrected Barometer.	Height in Feet.	Aneroid or Corrected Barometer.
ft.	in.	ft.	in.	ft.	in.
6000	24·875	8000	23·115	10000	21·479
6050	24·829	8050	23·072	10050	21·440
6100	24·784	8100	23·030	10100	21·401
6150	24·738	8150	22·988	10150	21·361
6200	24·693	8200	22·946	10200	21·322
6250	24·648	8250	22·904	10250	21·283
6300	24·602	8300	22·862	10300	21·244
6350	24·557	8350	22·820	10350	21·205
6400	24·512	8400	22·778	10400	21·166
6450	24·467	8450	22·736	10450	21·128
6500	24·423	8500	22·695	10500	21·089
6550	24·378	8550	22·653	10550	21·050
6600	24·333	8600	22·611	10600	21·012
6650	24·288	8650	22·570	10650	20·973
6700	24·244	8700	22·529	10700	20·935
6750	24·200	8750	22·487	10750	20·896
6800	24·155	8800	22·446	10800	20·858
6850	24·111	8850	22·405	10850	20·820
6900	24·067	8900	22·364	10900	20·782
6950	24·023	8950	22·323	10950	20·744
7000	23·979	9000	22·282	11000	20·706
7050	23·935	9050	22·241	11050	20·668
7100	23·891	9100	22·200	11100	20·630
7150	23·847	9150	22·160	11150	20·592
7200	23·803	9200	22·119	11200	20·554
7250	23·760	9250	22·079	11250	20·517
7300	23·716	9300	22·038	11300	20·479
7350	23·673	9350	21·998	11350	20·441
7400	23·629	9400	21·957	11400	20·404
7450	23·586	9450	21·917	11450	20·367
7500	23·543	9500	21·877	11500	20·329
7550	23·500	9550	21·837	11550	20·292
7600	23·457	9600	21·797	11600	20·255
7650	23·414	9650	21·757	11650	20·218
7700	23·371	9700	21·717	11700	20·181
7750	23·328	9750	21·677	11750	20·144
7800	23·285	9800	21·638	11800	20·107
7850	23·242	9850	21·598	11850	20·070
7900	23·200	9900	21·558	11900	20·033
7950	23·157	9950	21·519	11950	19·996
8000	23·115	10000	21·479	12000	19·959

"This Table * is intended more particularly for the graduation of Aneroids with a circle of Measures in Feet concentric with the ordinary circle of Barometric Height measured in Inches. The circle of Feet is to be read off, at the upper and lower stations, by the Index ; and the rule for measuring the height will be :—Subtract the reading at the lower station from the reading at the upper station ; the difference is the height in Feet.

"The Table supposes the mean temperature of the atmosphere to be 50° Fahrenheit or 10° Centigrade. For other temperatures the following correction must be applied :—Add together the temperatures at the upper and lower station. If this sum, in degrees of Fahrenheit, is greater than 100°, *increase* the height by $\frac{1}{1000}$ part for every degree of the excess above 100° ; if the sum is less than 100°, *diminish* the height by $\frac{1}{1000}$ part for every degree of the defect from 100°. Or, if the sum in Centigrade degrees is greater than 20°, *increase* the height by $\frac{1}{550}$ part for every degree of the excess above 20° ; if the sum is less than 20°, *diminish* the height by $\frac{1}{550}$ part for every degree of the defect from 20°."

Some Mountain Aneroids have a moveable scale in addition to the usual barometer scale, which is a fixture. The moveable scale is one of altitudes, and is designed especially for showing on the dial, without the aid of pencil and tables, the height of any given place above another. All that is necessary in using it is to set the index or zero to where the hand of the instrument points. On ascending a mountain, the hand of course

* Reproduced by kind permission of the Astronomer Royal.

travels backward, and as each division represents 100 feet, an *approximate* indication of the ascent is thus readily obtained. When not required for the estimation of altitudes, this Aneroid may be employed as a weather indicator in the same way as any other barometer. The thermometer which is usually attached admits of the temperature being observed and recorded. If the 1,000 feet lower be set to coincide with 31 inches, the scale of feet may be used as a fixed scale, and will correspond with Professor Airey's new Table.

Other Mountain Aneroids are furnished with a small *magnetic* compass; the indications of which should be received with some reserve on account of the aberrations caused by the steel portions of the instrument. To reduce these to a minimum the ordinary steel hand is replaced by a gold one.

If this or any other form of Aneroid be *recently*

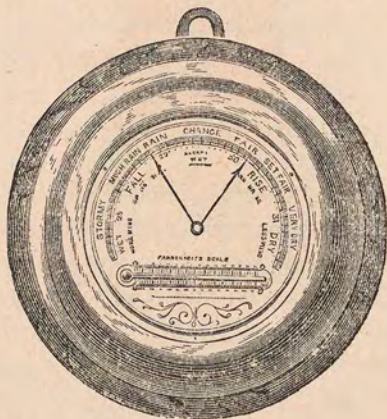


Fig. 8.

made, it will require occasional adjustment, until the

parts have worked together for some time. This can be readily done by turning the adjusting screw at the back of the instrument, comparing it at the same time with the readings of a Standard Mercurial Barometer when opportunity offers.

The stock of most opticians will be found to include, besides these, four other sizes, from $2\frac{1}{2}$ inches to $3\frac{3}{4}$ inches in diameter, which, still retaining the character of portability, may be styled "Pocket Aneroids."



Fig. 9.

Increasing in diameter still further, there will be found three sizes, from $4\frac{1}{2}$ to 8 inches in diameter, which, from the legible lettering and figuring on their

scales, are so suitable for use by mariners that they have been called Marine or Yachting Barometers.

Beyond these there are the still larger diameters of 10 inches, 14 inches, and 16 inches, for fixing in the hall or counting-house, and the Coastguard or Factory Aneroid, varying from 18 inches to 24 inches in diameter. These, however, will seldom be found in stock, but would be readily made to order by the opticians who keep the smaller sizes.

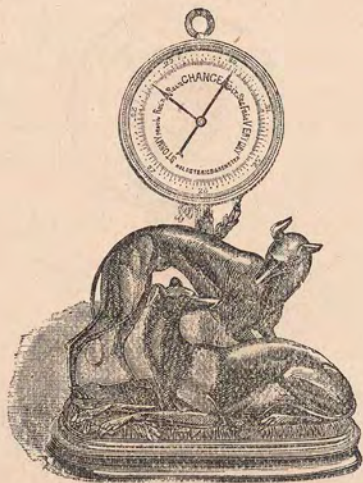


Fig. 10.

This variety of sizes may be classified under the five different heads of Cardboard, Enamel, Metal, and Open and Closed Dials. The cardboard dial is affixed exclusively to the cheapest form of instruments, but it need not be assumed on that account that they are less accurate than metal, since the error (if any) would

arise, not in the material on which the scale is engraved, but in the manner of attaching it to the metallic portion of the instrument, and for this the security of the purchaser must be the character and standing of the house where the purchase is made. The scales on metal dials being engine-divided specially for each instrument are of course more correct than those just described.

Those instruments which are furnished with enamel dials are specially adapted for use at sea, on account of the incorrodible nature of the porcelain surface.

Patterns are now being produced, and may be obtained at most opticians, having great similarity in external appearance to the Wheel Mercurial Barometer, but smaller in size. To such as prefer this form, these will recommend themselves as suitable for suspension in the entrance hall or lobby.

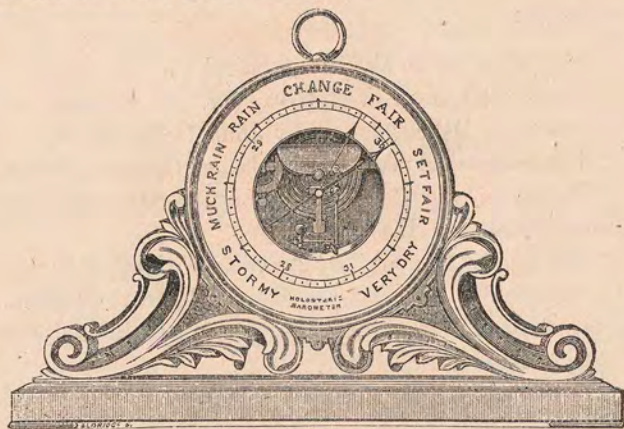


Fig. 11.

With such authorities as those which have been

cited on pages 8 and 9, no hesitation need now be felt in employing the Aneroid Barometer as a weather indicator, and making daily records of its indications, especially if the precaution be adopted of comparing it at intervals of twelve months with a Standard Mercurial Barometer, usually possessed by the opticians supplying the instrument.

In view of this it has been deemed desirable to append an Explanatory Card by Admiral Fitzroy, and to recommend the purchase of a very handy little note-book sold by opticians, with a pencil and india-rubber band complete. It is called the "Pocket Meteorological Register and Note-Book," and by its aid the most interesting diagrams may be made, showing the fluctuations of the barometer from day to day. The following works may also be consulted with advantage by those desiring to pursue the study of meteorology as a science :—

"The Weather Book," by Admiral Fitzroy, F.R.S.

"Complete Course of Meteorology," by Kæmtz.

"Practical Meteorology," by John Drew, Ph.D.

"Hygrometrical Tables," by James Glaisher, F.R.S.

"Tables of the Corrections for Temperatures," by James Glaisher, F.R.S.

"Barometer Manual," by Admiral Fitzroy, F.R.S.

"Instruction for taking Meteorological Observations, with Tables, Diagrams, &c.," by Colonel Sir Henry James, F.R.S.

EXPLANATORY CARD.

BY THE LATE VICE-ADMIRAL FITZROY, F.R.S., ETC.

WEATHER-GLASSES.

THE BAROMETER RISES

for Northerly wind

(including from North-west, by the *North*, to the Eastward),

for dry, or less wet weather,—for less wind,—or for more than one of these changes:—

EXCEPT on a few occasions when rain, hail, or snow comes from the Northward with *strong* wind.

THE BAROMETER FALLS

for Southerly wind

(including from South-east, by the *South*, to the Westward),

for wet weather,—for stronger wind,—or for more than one of these changes:—

EXCEPT on a few occasions when *moderate* wind with rain (or snow) comes from the Northward.

For change of wind toward Northerly directions,—

A THERMOMETER FALLS.

Moisture or dampness in the air (shown by a hygrometer,) increases BEFORE rain, fog, or dew.

For change of wind toward Southerly directions,—

A THERMOMETER RISES.

On barometer scales the following contractions may be useful:—

RISE	FALL
FOR	FOR
NORTH	SOUTH
N.W.—N.—E.	S.E.—S.—W.
DRY	WET
OR	OR
LESS	MORE
WIND.	WIND.
EXCEPT	EXCEPT
WET FROM	WET FROM
NORTH.	NORTH.

Add one-tenth of an inch to the observed height for each hundred feet the barometer is above the half-tide level.

The *average* height of the barometer, in England, at the sea-level, is about 29.94 inches; and the *average* temperature of air is nearly 50 degrees (London latitude).

The thermometer falls about one degree for each three hundred feet of elevation from the ground, but varies with wind.

“When the wind shifts against the sun,
Trust it not, for back it will run.”

First rise after very low
Indicates a stronger blow.

Long foretold—long last,
Short notice—soon past.

(In South Latitude read South for North.)

NOTE.—In the desire to express as much as possible in a few words, on account of the contracted space on barometer scales, a little obscurity has been unavoidably introduced, *e. g.*, “except wet from N.E.” It means that, though the barometer may rise and indicate fair weather, it is uncertain, *if* the wind be N.E.; an important point to be remembered when using the barometer as a weather-glass.

As illustrative of the sensitive nature of the Aneroid in comparison with the sluggish action of cheaper forms of mercurial barometer, it may be mentioned that it shows, in a most interesting manner, the various inclines on a line of railway, even at the utmost speed of the engine. This has been observed by the writer, and notable instances of it occur in this country at Sydenham, between Sevenoaks Junction and Rochester, and at Meopham on the London, Chatham, and Dover line. Instances of this kind could be cited *ad infinitum*, and the action is still more striking on the Continent; while any one desirous of testing this quality of *superior sensitiveness* in the Aneroid may do so by ascending, Aneroid in hand, from the basement to the attic of his house, note the gradual fall of the index hand from “fair” to “change,” and thus calculate the height of his dwelling by direct barometric observation.

The word “change” on barometer scales is considered by some as being placed too low at 29·5, the mean height of the barometer being nearer 30. This is so fully acknowledged by the French, that they place it at 76 centimetres, which corresponds nearly with the mean height of the barometer in England.

RULES FOR FORETELLING THE WEATHER,
ADAPTED FOR USE
WITH ANEROID BAROMETERS.

A RISING BAROMETER.

"Fair weather after you."—*Shakspeare*.

A "rapid" rise indicates unsettled weather.

A "gradual" rise indicates settled weather.

A "rise" with dry air, and cold increasing in summer, indicates wind from Northward; and if rain has fallen better weather is to be expected.

A "rise" with moist air, and a low temperature, indicates wind and rain from Northward.

A "rise" with southerly wind indicates fine weather.

A STEADY BAROMETER,

"Many can brook the weather that love not the wind."—*Shakspeare*.
with dry air and seasonable temperature, indicates a continuance of very fine weather.

A FALLING BAROMETER.

"So foul a sky clears not without a storm."—*Shakspeare*.

A "rapid" fall indicates stormy weather.

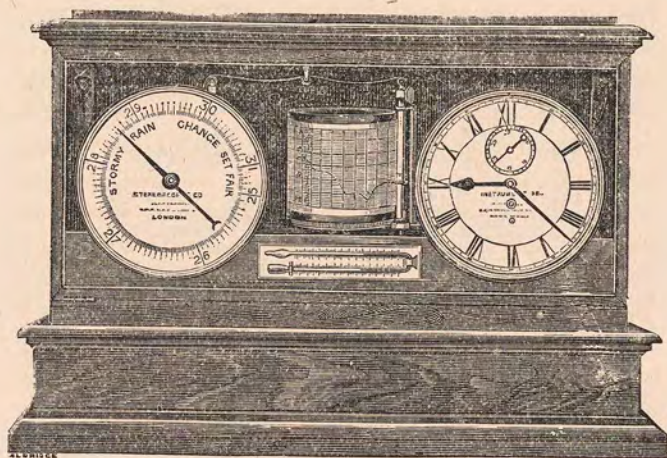
A "rapid" fall, with westerly wind, indicates stormy weather from Northward.

A "fall," with a northerly wind, indicates storm, with rain and hail in summer, and snow in winter.

A "fall," with increased moisture in the air, and the heat increasing, indicates wind and rain from Southward.

A "fall" with dry air and cold increasing (in winter) indicates snow.

A "fall" after very calm and warm weather indicates rain with squally weather.



The illustration is one-eighth the size of the instrument.

Fig. 12.

THE HOURLY SELF-RECORDING ANEROID BAROMETER.

This instrument is designed to show the various fluctuations which may have taken place in the Barometer in the interval between the stated hours of observation. It consists of a large and powerful Aneroid and an eight-day clock, each with eight-inch dials; between these is placed, in a vertical position, a cylinder 4 inches in diameter. The circumference of this cylinder is furnished with a toothed wheel, which works in an endless screw at the back of the instrument; it has a paper attached to it ruled to coincide with the Barometer scale. This paper, besides being ruled horizontally into inches and tenths to correspond with the Barometer scale, is divided vertically throughout its entire length of twelve inches into seven prin-

cipal and seven minor divisions, indicated by darker and lighter lines. The dark lines represent the noon, and the lighter lines the midnight of each twenty-four hours. The paper thus lasts one week. Near the paper, a pencil guided by a rod of metal is moved up and down as the action takes place in the Aneroid, and at every hour the pencil is made to mark the paper by simple mechanism connected with the clock. A system of levers in connection with the clock produces a smart tap or blow on the Aneroid movement three times in every hour to overcome any slight friction, and insure a due response to the pulsations of the vacuum chamber.

By this means a black dotted curved line is produced, showing at a glance the height of the Barometer—whether it is falling or rising—for how long it has been doing so, and at what rate the change is taking place—whether at the rate of one-tenth per hour, or one-tenth in twenty-four hours, facts which can only be obtained by very frequent and regular observations from an ordinary Barometer, but which are nevertheless essential to a reliable “weather forecast.”

The instrument has the advantage of freedom from complication, and is designed especially to suit the general public; it is handsome in appearance, and not easily put out of order, being admirably adapted for public libraries, the reading-rooms of clubs, &c., as well as for use by meteorological observers generally.

NOTE.—In measuring altitudes, the Aneroid should be kept as nearly as possible at a uniform temperature, and should be allowed to acquire this temperature before starting on a day's excursion.

WEATHER WISDOM.

The following are a few of the more marked signs of weather, described in the late Admiral Fitzroy's valuable Weather Book :—

Whether clear or cloudy, a rosy sky at sunset presages fine weather ; a sickly-looking *greenish* hue, wind and rain ; a dark (or *Indian*) red, rain ; a red sky in the morning, bad weather or much wind (perhaps rain) ; a grey sky in the morning, fine weather ; a high dawn, wind ; a low dawn, fair weather.*

Soft-looking or delicate clouds foretell fine weather, with moderate or light breezes ; hard-edged, oily-looking clouds, wind. A dark, gloomy blue sky is windy, but a light, bright blue sky indicates fine weather. Generally, the *softer* clouds look the less wind (but perhaps more rain) may be expected, and the harder, more 'greasy,' rolled, tufted, or ragged, the stronger the coming wind will prove. Also—a bright yellow sky at sunset presages wind, a pale yellow wet : therefore by the prevalence and kind of red, yellow, or other tints, the coming weather may be foretold very nearly ; indeed, if aided by instruments, almost exactly.

Small inky-looking clouds foretell rain ; light scud

Before reading, gently wave the instrument to and fro to remove possible errors of friction, take the reading with the face of the instrument in a horizontal position, and use one eye, which should be held vertically over the needle.

* A 'high dawn' is when the first indications of daylight are seen above a bank of clouds. A 'low dawn' is when the day breaks on or near the horizon, the first streaks of light being very low down.

clouds driving across heavy masses show wind and rain ; but if alone may indicate wind only.

High upper-clouds crossing the sun, moon, or stars, in a direction different from that of the lower clouds, or the wind then felt below, foretell a change of wind *toward their direction*.

After fine clear weather, the first signs in the sky of a coming change are usually light streaks, curls, wisps, or mottled patches of white distant clouds, which increase, and are followed by an overcasting of murky vapour that grows into cloudiness. This appearance, more or less oily or watery, as wind or rain will prevail, is an infallible sign.

Usually, the higher and more distant such clouds seem to be, the more gradual, but general, the coming change of weather will prove.

Light, delicate, quiet tints or colours, with soft undefined forms of clouds, indicate and accompany fine weather ; but unusual or gaudy hues, with hard, definitely outlined clouds, foretell rain, and probably strong wind.

Misty clouds, forming or hanging on heights, show wind and rain coming, if they remain, increase, or descend. If they rise, or disperse, the weather will improve or become fine.

Dew is an indication of fine weather, so is fog. Neither of these two formations occurs under an overcast sky, or when there is much wind. One sees fog occasionally rolled away, as it were, by wind, but seldom or never *formed* while it is blowing.

Remarkable clearness of atmosphere near the horizon, —distant objects, such as hills unusually visible, or

raised (by refraction)*—and what is called ‘a good *hearing* day’—may be mentioned among signs of wet, if not wind, to be expected.

More than usual twinkling of the stars, indistinctness or apparent multiplication of the moon’s horns; haloes, ‘wind-dogs,’† and the rainbow, are more or less significant of increasing wind, if not approaching rain with or without wind.

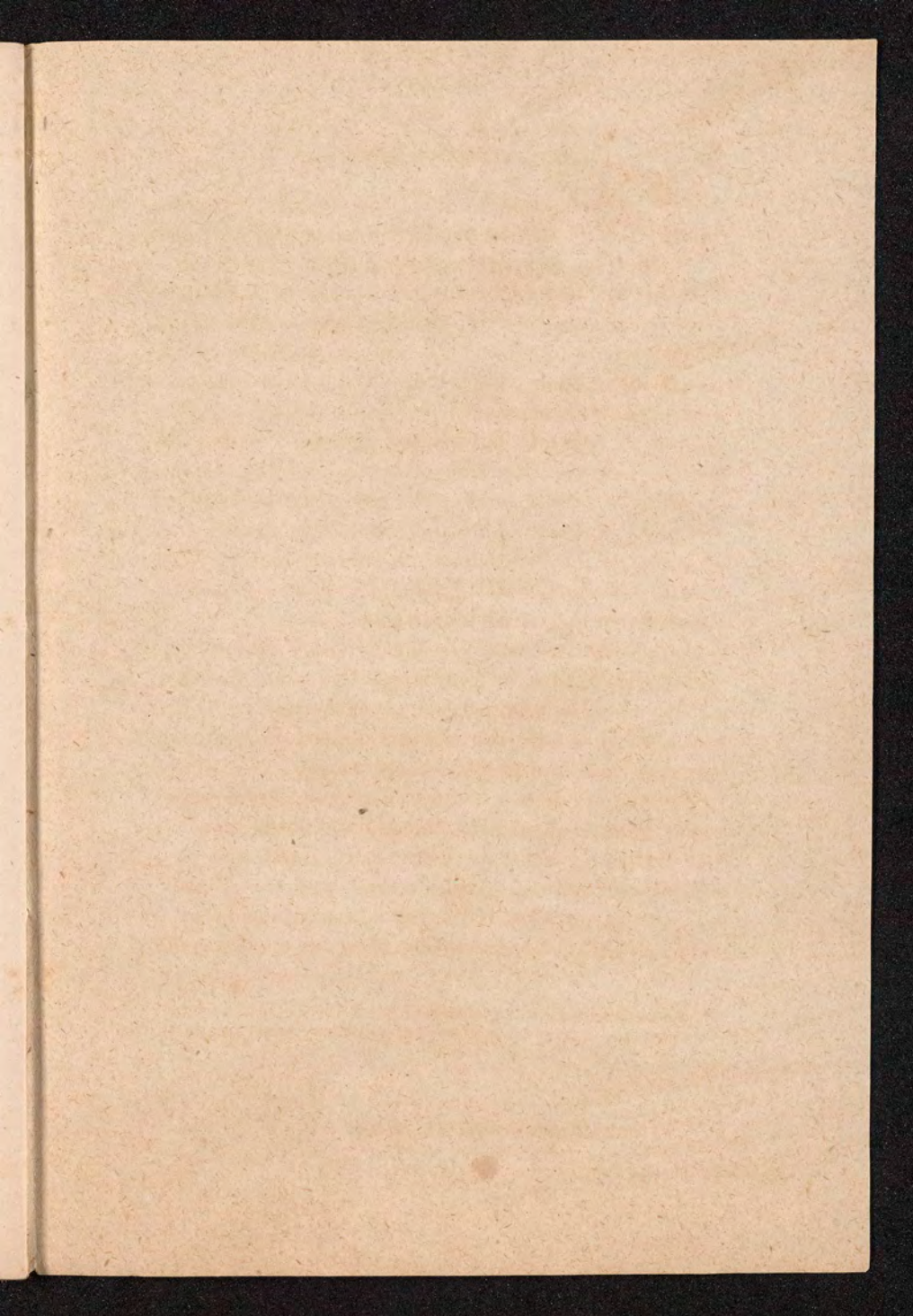
Observers should be advised to *mark* a true E. and W. line, *about the time of the equinox*, by the sun at rising or setting, and by it give their bearings or directions of wind. And they should take its direction from that of the *lower* clouds (when they are not very distant), compared with that of vanes and smoke, in preference to any other indication.

Much more care is required in noticing the veering, backing, shift, turn, or gyration of the wind, than has usually been thought necessary. Very rarely has the way the wind *went round* been noticed in ordinary registers, though of material consequence.

While saying so much of the Mercurial Barometer, it would be an injustice to the Aneroid not to mention that fourteen years’ experience of this small and *very* portable barometer—at sea, on land, and travelling—has induced its *high* recommendation (when *set properly*) as an excellent weather-glass for small vessels or boats.

* Much refraction is a sign of easterly wind, veering southward.

† Fragments or pieces (as it were) of rainbows (sometimes called ‘wind-galls’) seen on detached clouds.



Houlston & Sons' Popular Scientific Works.

TWELFTH THOUSAND. PRICE ONE SHILLING.

THE MODEL STEAM ENGINE

HOW TO BUY, HOW TO USE, & HOW TO MAKE IT.

By "A STEADY STOKER."

96 pages, crown 8vo., 60 Illustrations, Illuminated Cover.

"Just the book for those who are making their first attempts at engine-building on a small scale."—*Mechanics' Magazine*.

"With such a guide I should have worked away pleasantly and successfully."—*Fun*.

"The directions are clear, succinct, and to the purpose, and the practical instructions embrace every subject down to lacquering and soldering."—*Boy's Journal*.

"Illustrated with numerous and well-executed drawings and diagrams, and may be confidently recommended."—*Monmouthshire Merlin*.

~~~~~  
TWENTIETH THOUSAND. PRICE ONE SHILLING.

## THE MAGIC LANTERN

### HOW TO BUY, HOW TO USE IT,

AND

### HOW TO RAISE A GHOST.

By "A MERE PHANTOM."

96 pages, crown 8vo., 70 Illustrations, with Illuminated Cover.

"It is the most complete treatise on the subject with which I am acquainted, and cannot fail to have a wide circulation."—SIR DAVID BREWSTER, D.C.L., F.R.S., &c., &c.

"Under 'A Mere Phantom's' tuition, Paterfamilias, or any other man, may soon learn to 'work a Lantern' to the satisfaction of a highly critical assembly of boys and girls."—*Athenæum*.

"The advice necessary to enable a purchaser to obtain a good instrument, and to manage it successfully, is here prepared to his hand."—*Monmouthshire Merlin*.

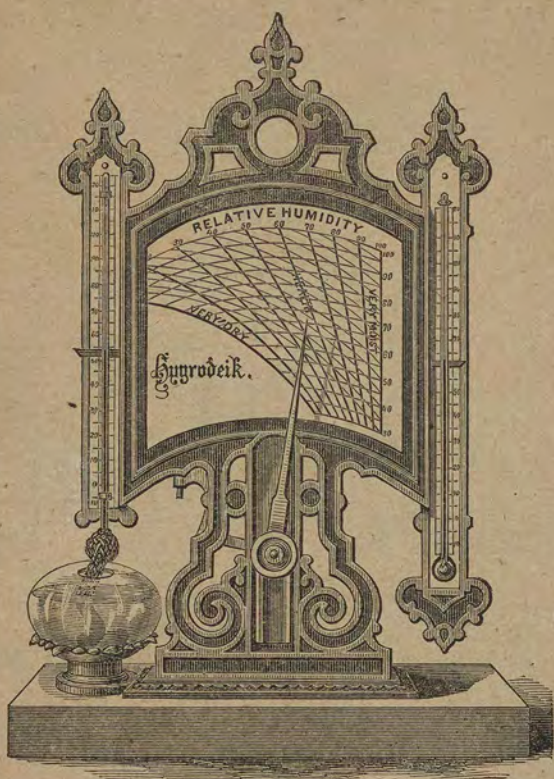
"Neatly printed in a large, bold, readable type."—*British Journal of Photography*.

"Containing in a compact form just the information important to possess."—*Photographic News*.

"Will be found a most useful companion by those who employ the instrument either for amusement or instruction."—*Popular Science Review*.

LONDON: HOULSTON AND SONS, 65, PATERNOSTER ROW.

Don't copy



# Edson's Hygrodeik,

FOR HYGIENIC AND MECHANICAL PURPOSES,

MANUFACTURED BY

N. M. LOWE,

No. 103 COURT STREET, BOSTON.

Patented in the United States, England, and France.

PRICE FROM \$15 TO \$25 (Tucker Bronze \$15).



## PRACTICAL UTILITY

OF

## THE HYGRADEIK.

*It is a guide which, if followed, will enable us to maintain an atmosphere in inhabited rooms of such a nature —*

*That the most delicate lungs will not suffer from atmospheric causes.*

*That the healthy will feel a degree of comfort never before experienced within doors.*

*That speaking or singing becomes a pleasure.*

*That plants may be made to bloom in it as well as in the conservatory.*

*N.B. — By following the indications of this instrument, at least twenty per cent of fuel may be saved.*

## Edson's Hygradeik.

It has long been known by observing men that air is not healthy, or comfortable, unless it contains a certain amount of moisture, — too much or too little being equally unhealthy, — and every one who has given much time and thought to the subject of ventilation must be aware how essential it is to know, from some other source than from our own ever-varying feelings, the real state of the air in which we exist, and upon which our life and enjoyment depend. To assist in the solution of this problem, is the object of the Hygradeik.

In the sitting-room, school-room, and sick-room, this instrument is invaluable, as it shows at once if the air is in an unhealthy state, and points out the remedy. In conservatories, grape-houses, &c., it is very valuable, as it will enable a comparatively inexperienced person to keep the air in a healthy condition for the plants, and thus avoid the pests of mildew and insects. In cotton mills, also, it is necessary to maintain a constant degree of moisture, or the threads will become dry and highly charged with electricity, which causes the fibres to stand out from the threads and thus renders them liable to be broken.

It is believed that, with slight experience, with this instrument as a guide, any person with ordinary intelligence may maintain a healthy, pure, and genial atmosphere within his dwelling; or, using it out of doors, may ascertain the comparative salubrity of different locations, and predict changes in the weather.

The Hygradeik indicates the state of the atmosphere in relation —

1st. To its actual temperature as indicated by the ordinary thermometer (or the dry bulb thermometer of this instrument).

2d. Sensible temperature, or the temperature due to evaporation (indicated by the wet bulb thermometer of this instrument).

The fact that the temperature due to evaporation is often quite different (sometimes amounting to 15 degrees), from the temperature as indicated by the thermometer, is one of

very great importance, and one that is very commonly overlooked.

When we cover a thermometer bulb with a thin piece of cloth, and wet that cloth, we have an instrument which is sensible to the temperature of the air in precisely the same degree that our lungs are: that is, a person may feel too warm, or too cold, in a room the temperature of which (as indicated by the common thermometer) is 70 degrees; for the same reason that, in such a room, the wet bulb thermometer may indicate a temperature of 70 degrees, or of only 55 degrees; the first of which, 70 degrees, is too warm, while the latter, 55 degrees, is much too cold.

The amount of difference between the dry and wet bulb thermometers depends directly upon the amount of moisture in the air. If the air contains all the moisture that it is capable of holding, as often occurs in wash and bathing rooms, it will be found that there is no difference in the readings of the two thermometers; but if the air is very dry, as we often find it to be in artificially warmed apartments, the readings of the two thermometers may be very different.

3d. The relative amount of moisture in the air.

Air absorbs and holds in suspension watery vapor in the same manner that a sponge will hold water; but the amount that a given bulk of air will hold depends upon its temperature. Thus one cubic foot of air, at 32 degrees, will hold in suspension but 2 grains of water, while one cubic foot of air, at 68 degrees, will hold  $7\frac{1}{2}$  grains. When air at 32 degrees has 2 grains of watery vapor in it, it is said to be saturated; if it has but half this amount, we call it half saturated. When air is saturated, that is, contains all the moisture that it is capable of holding, we say that its relative humidity is 100; if it contains three-fourths of the amount it is capable of holding, we say that its relative humidity is 75 per cent; or if one-half, 50 per cent, &c., &c.

We see from this that the relative humidity of the air does not express at all the absolute amount of watery vapor present. For instance, the relative humidity of air at zero, may be, say, 90 per cent, and yet contain less watery vapor than air at 70 degrees, whose relative humidity is but 30 per cent.

4th. The Dew-Point.

"A glass tumbler filled with cold water, in summer, is soon bedewed with moisture, not, as is frequently imagined, because the water oozes through the tumbler, but because the air around it is cooled, and its moisture precipitated upon it. The same would occur in winter if the tumbler were brought into a close room in which many persons were assembled, and the air loaded with the accumulated vapor exhaled from



# PRACTICAL UTILITY

OF

## THE HYGRODEIK.



*It is a guide which, if followed, will enable us to maintain an atmosphere in inhabited rooms of such a nature—*

*That the most delicate lungs will not suffer from atmospheric causes.*

*That the healthy will feel a degree of comfort never before experienced within doors.*

*That speaking or singing becomes a pleasure.*

*That plants may be made to bloom in it as well as in the conservatory.*

*N.B.—By following the indications of this instrument, at least twenty per cent of fuel may be saved.*

their lungs and skin. From the same cause, the cold windows of a crowded lecture-room are constantly covered with minute drops of water, which soon collect together and run down the glass in streams.

"The highest point of the thermometer at which vapor begins to be deposited by the air, is called the *dew-point*; it is the point at which dew begins to form."

5th. The absolute amount expressed in grains of water contained in a cubic foot of air, at the temperature, and relative humidity, as shown by the instrument.

6th. The force of vapor expressed in inches of water; in other words, the depth of water that would be deposited upon the earth by the condensation of all the vapor held in the atmosphere.

### DIRECTIONS FOR MAINTAINING A HEALTHY ATMOSPHERE.

A full-grown person, in health, should have a supply of fresh air amounting to at least one thousand cubic feet per hour; in sickness much more is required.

To supply this amount of air to an apartment of the average size of our sitting-rooms, and under ordinary conditions, there should be an inlet and an outlet, each of an area of at least one square foot; both orifices should be so arranged as to be under perfect control, by means of blinds, registers, or valves.

Rooms warmed by furnaces, open fire-places, or by air that passes through coils of steam or hot water pipes, are usually well supplied with fresh air.

Apartments warmed by air-tight coal or wood stoves, or by steam coils and radiators, should have especial arrangements for supplying fresh air; without such especial arrangements these rooms are unfit for habitation.

However large and pure the supply of air is to any apartment, and however it may be warmed, it will still be oppressive and unhealthy if moisture is not added, in proportion to the rise in temperature that the air undergoes while being conveyed from out of doors to the places where it is to be breathed.

The very important fact that air, at a low temperature, can contain but a small amount of moisture in comparison to that that it should contain if raised to a high temperature, is usually entirely overlooked; and the furnace or steam-heating apparatus is said to dry the air.

Let the air of a warm room be ever so dry, it will be found upon analysis that a cubic foot of it contains *more* moisture



J. FERGUSON, Assistant Astronomer of U. S. Observatory.

J. R. EASTMAN, Professor of Mathematics, U. S. Navy.

THOS. ANTISELL, M.D., Professor in Medical Department,  
Georgetown College; Chemist to Agricultural Department,  
U.S.; &c. &c.

THOS. HILL, President of Harvard College.

JOSEPH LOVERING, Professor of Natural Sciences.

JOSIAH P. COOK, jr., Professor of Chemistry.

Prof. G. M. Searle, of Nautical Almanac.

GEO. F. BARKER, Professor of Chemistry, Yale College.

J. D. RUNKLE, Professor of Mathematics, Institute of Technology.

EDWIN S. RITCHIE, Philosophical Instrument Maker.

STEPHEN L. GOODALE, Secretary Maine Board of Agriculture.

CHICKERING & SONS.

*Prof. J. T. Trazer, Univ. Penn.*

Relative Humidity.

Items or Factors:

Temperature of the Air (Dry bulb Thermometer)

Difference between Wet & Dry bulb temperatures  
(Observed Degrees)

Difference between Temperature of the Air and the Dew point

Proportion between this last difference and the Observed Degrees (See Tables)

Vapor pressure of air at obtained Dew point (Tables)

Vapor pressure when dew point is at observed temperature of the air (i.e., saturation at that temperature)

Proportion between these last items, saturation pressure being 100.

*Temperature. Rel. Humidity.*



of land was seen at all. On March 17 the *Challenger* anchored near Melburne, all well.

A TRAIN arrived at Algiers from Oran on the 18th inst., six hours behind time, having been delayed by a thick layer of grasshoppers which covered the rails.

THE first meeting of the Board of Governors of the Yorkshire College of Science was held in the Philosophical Hall, Leeds, on April 30. Dr. Heaton was called upon to preside. The business of the meeting was the election of the president, treasurer, council, and auditor for the ensuing year, also the appointment of six endowed grammar schools and ten institutions, each of whose governing bodies should elect a Governor of the College. Lord F. C. Cavendish, M.P. and Mr. W. B. Denison were respectively elected president and treasurer of the College. The following grammar schools were placed in Schedule A:—Leeds, Bradford, Batley, Halifax, Wakefield, and Giggleswick. The institutions placed in Schedule B were the Philosophical Societies at York, Leeds, Bradford, Halifax, Sheffield, and Huddersfield, the Clothworkers' Company of the City of London, the West Riding Coalmasters' Association, the Cutlers' Company, Sheffield, and the Trustees of Ackroyd Charity. Each of these bodies is invited to nominate a member of the Board of Governors.

THE *Times of India* states that Dr. David Wilkie has been appointed by the Government of India to conduct a scientific investigation into the nature, pathology, and causation of the fever prevailing in the Burdwan and Hoogly districts. He is to work in communication with Dr. Lewis and Dr. Cunningham, and under the direction and general superintendence of the Sanitary Commissioner with the Government of Bengal.

UNDER the direction of Mr. Liversidge, Professor of Geology and Lecturer in Practical Chemistry, the Laboratory of the Sydney University is being improved in a way to make it similar to the Laboratory of the Royal School of Mines and the University of Cambridge, and to afford appliances for the proper conduct of the exercises in practical chemistry.

MR. WILLIAM H. DALL resumed his Alaskan explorations under the U. S. Coast Survey, about April 20, at which date he expected to sail for Sitka and more northern points. It is probable that his labours during the present season will be in the neighbourhood of Cook's Inlet and the peninsula of Alaska, and the coast of the mainland as far as the islands of Nunivah and St. Michael's. His duties are to complete a coast pilot of the territory, and to make careful magnetical and other observations. Should his regular work permit, he hopes to make large collections in natural history and ethnology, in continuation of those of previous seasons, and transmitted through the Coast Survey Office to the National Museum at Washington, and which have done him and the Survey so much credit.

HEFT V. of Petermann's *Mittheilungen*, contains Contributions to the climatology and meteorology of the East Polar Sea, by Prof. Mohn; an account of some of the results of Gerhard Rohlfs' expedition into the Lybian desert, with a map; and a German translation of the journal kept by Jacob Wainwright, while marching with Livingstone's body from Central Africa to Zanzibar. A copy of this journal was obtained by the late Richard Brenner, the African traveller and Austrian Consul at Zanzibar.

THE additions to the Zoological Society's Gardens during the last week include a Crested Curassow (*Crax alector*) from Guiana, presented by Mr. G. Bruce; a Ring-necked Parakeet (*Palaeornis torquata*) from India, presented by Mrs. A. de Normanville; a Coati (*Nasua nasica*) from South America, presented by Miss E. Waller; a Common Paradoxure (*Paradoxurus typus*) from India, presented by Mr. G. R. Colbeck; two Muscovy Ducks (*Cairina moschata*) from Monte Video, presented by Mr. S. J. Oliff; a Koodoo (*Strepsiceros kudu*) from Africa, deposited.

# THE METEOROLOGICAL CONGRESS AT VIENNA \*

## II.

WITH reference to the organisation of a system of meteorological observations on the Chinese coasts, for advice regarding which the Congress was applied to, a report was adopted setting forth the general principles of organisation suited to the circumstances of China.

In addition to the above, General Myer, as commissioned by the War Department of the United States, proposed that with a view to their exchange at least one uniform observation of such character as to be suitable for the preparation of synoptic charts be taken and recorded daily and simultaneously at as many stations as practicable throughout the world. This proposal the conference adopted, and, as the readers of NATURE are aware, is now in operation.

On these various subjects much valuable information will be found in the discussions in the Reports of the Committees, and in the communications printed in the Appendices, particularly on the subjects of weather telegraphy, sheet lightning, atmospheric electricity, ozone, clouds, atmometers, rain-gauges, and the protection of thermometers.

In the review of the Leipzig Conference (NATURE, vol. viii. p. 342) a hope was expressed with reference to the protection of the thermometers, which is really the vital question of meteorology, that the Vienna Congress would face it, seriously discuss it, and either arrive at some decision, or at least suggest some steps to be taken that might ultimately lead to the uniformity which is so imperatively called for. Unfortunately this has not been done.

We say unfortunately, for scarcely two of the head observatories in the British Isles and on the Continent, where continuous or hourly observations are recorded, could be named at which there is uniformity in the protection of the thermometers as respects the box in which they are placed, height above the ground, and position with reference to walls and other surrounding objects. Now till uniformity in the position and exposure of the thermometers be obtained, there can be no comparableness in the results, and consequently the observations are of little value as data for the determination of what must be regarded as the most important fundamental facts on which the science rests, viz. the diurnal and seasonal march of the temperature and humidity of the atmosphere. It is only from the range of the temperature and the humidity of the atmosphere of different regions as ascertained by observations made on a uniform method that we are furnished with physical data for the scientific treatment of such questions as the daily fluctuations of the barometer, and the changes and movements of the atmosphere generally.

Prof. Wild's paper on the exposure of thermometers (p. 77) we recommend to the careful consideration of meteorologists. His observations, instituted at the Pulkowa Observatory at heights of 6½ ft., 52 ft., and 86 ft., are, as far as we are aware, the best that have yet been made for the purpose of disclosing the influence which mere height, as such, has on the temperature. The thermometers were placed on a scaffolding constructed of timber lightly put together, and standing in an open field, being in these essential points in striking contrast with those placed for a similar object on the Chinese pagoda in the Royal Gardens at Kew, it being evident that observations made with thermometers placed like those at Kew will give results which possess little, if any, value in an inquiry touching the vital question of the position and exposure of thermometers.

From the small differences among the mean temperatures he obtained at the different heights, Wild concludes that the height of thermometers above the ground need not necessarily be the same, but may vary between 6 ft. and 33 ft. The differences he obtained as regards mean temperature, though by no means insignificant, are doubtless small; but when we regard the maxima and minima and the observations at particular hours, which in their practical bearings are so important, the influence of height becomes well marked. Hence, if in any meteorological system uniformity as respects height be disregarded, the results so obtained fail to supply the data necessary for a satisfactory comparison of climates. This condition is all the more indispensable when the thermometers are placed at a height of 4 ft. above the ground, at which they should be placed as being the height which gives the best results as regards the application of meteorology to human mortality and other important questions affecting animal and vegetable life.

\* Continued from p. 18.



We are probably yet a long way from any simple method, suited for general adoption, for observing the *true temperature of the air* at any place by means of the thermometer, so as to eliminate completely the disturbing influence of radiation as regards the thermometer and its protecting screen, or box. This is a problem which may well engage the serious attention of the chief observatories of this and other countries for some years to come. The inquiry may be conducted by ascertaining the true temperature of the air at different hours and seasons by Joule's method, described in a communication to the Philosophical Society of Manchester, November 26, 1867, and comparing the results with those simultaneously obtained by thermometers protected in boxes of different constructions and materials. On this point Wild's paper contains some very valuable observations—valuable, not because they are conclusive, but because they are suggestive, as indicating the line of inquiry which should be pursued. In the meantime all that can be secured is *uniformity*, which would be sooner attained if meteorologists recognised that the following positions of the thermometer are, on physical grounds, inadmissible in researches into the hourly fluctuations of the temperature and humidity of the air, viz. the roofs of houses, close or near to walls, over bare soil, in the shadows of trees, walls, or other obstructions, or outside windows. Let it be recognised that observations made under these conditions are of less, and in most cases of no value, then the adoption of 4 ft. as the standard height would follow, and with it the question of uniformity would be almost, if not altogether, settled.

As regards *rain-gauges*, the Congress adopted as the best form for the receiver of the rain-gauge the circular one, with a diameter of 14 in., and at a height of 3 ft., or better 4½ ft., above the ground, a decision which was agreed to by all the delegates except Mr. Buchan, who lodged his protest against it. We have taken the trouble of looking over Mr. Symons' last published *British Rainfall*, and observe that there are not more than half a dozen gauges in the British Isles of this dimension. The readers of NATURE are no doubt aware of the extensive experiments and observations made on this subject in England for some years past, and published annually in the *British Rainfall*, from which it has been experimentally proved that gauges of all sizes from 3 in. to 24 in. inclusive collect amounts not differing more than 2 per cent. from each other. We have had a communication from Mr. Scott, by which we are glad to learn that the Meteorological Office has resolved to retain at its stations the 8 in. gauges hitherto in use. This decision as to the size of the gauge a future Congress will no doubt rescind. Equally in error is the decision as regards height of gauge above the ground, especially large gauges. It is certain from numerous observations made on the subject, that gauges placed at from 3 ft. to 4½ ft. above the ground will not indicate with sufficient correctness the amount of the rain which falls at the place of observation in cases where wind accompanies the rain, owing to the disturbance caused by the obstruction offered by the gauge itself, and by the eddies generated within the funnel. Now owing to the enormous dragging influence of the earth's surface of the wind, these disturbing effects are reduced several fold at the surface and at one foot above it as compared with 3 to 4½ ft. high. On these grounds we cannot recommend British Meteorologists to follow the decision of the Congress. Owing to the extreme variableness of the rainfall, particularly in such countries as Great Britain, where the surface is so uneven, the proper observation of the rainfall requires twenty times more observers than are required to observe any of the other meteorological elements. It is therefore well that a cheap gauge is also a good one, since it facilitates an adequate observation, through numerous observers, of the rainfall, which from its practical and scientific bearings it is so important to know.

In fixing the hours of observation it is essential that those hours be selected which give approximately the mean temperature of the day. The combination of hours which seems to have been most approved both at the Leipzig Conference and the Vienna Congress, and referred to by some very able meteorologists as unconditionally the best, is 6 A.M., 2 P.M. and 10 P.M. The merits of this combination consist in the equal interval of eight hours between the observations, in the close approximation to the daily mean temperature it affords, and in its suitability for tri-daily charting of the weather. It is, however, a combination of hours which, since it all but absolutely excludes the hours of occurrence of the daily thermometric, barometric, and hygrometric extremes and means, cannot be recommended as generally suitable for meteorological observations of all countries.

Indeed, its adoption in tropical and sub-tropical countries would be a blunder. As generally suitable for all latitudes, and for the observation of the principal daily atmospheric phases of temperature, pressure, &c., the best hours are 9 A.M. 3 P.M. 9 P.M., or 10 A.M. 4 P.M. 10 P.M., it being assumed that self-registering thermometers are also used.

We are glad to see that it has been proposed to convene another Meteorological Congress in three years, and hope that some of the questions that form the life-blood of the science will be seriously and adequately discussed by the members of that Congress. The more important of these questions are:—(1) The position and protection of the thermometer for the temperature of the air; (2) A more satisfactory method for observing the humidity of the air, and of making the deductions therefrom; (3) The observation of earth-temperatures, especially at and near the surface, and the depth at which fixed thermometers cease to be suitable; (4) Solar and terrestrial radiation; (5) The examination of the drying qualities of the air by anemometers, so as to secure comparable results; (6) A statement of the conditions which anemometrical stations ought to fulfil, so that the instrument shall indicate the true movement of the air over the region where it is placed, or, if this be unattainable, a means of valuing the observations so as to approximate to it; \* (7) Anemometers (Wild's, &c.) for stations of the second order, with which trustworthy observations of wind-force may be made; and anemometers of velocity which admit of their errors being readily ascertained from time to time; (8) an adequate nomenclature of clouds; and (9) the question of atmospheric electricity.

Though the Vienna Congress can properly be regarded as having only concerned itself with questions lying on the outskirts of meteorology, it has done commendable work in thus paving the way for future Congresses, entering on the really important practical questions which united action on the part of meteorologists can alone settle. Until tolerable uniformity be arrived at as regards (1), (2), (5), (6), (7), and (8), in the above paragraph, meteorologists can scarcely be said to have begun to collect data of such a nature as will satisfy our best physicists, and thus lead them to undertake the investigation of the more important of the intricate and difficult problems of the science.

#### M. COGGIA'S COMET

THE following is an ephemeris of the comet discovered by M. Coggia. It will be seen that the comet will be vastly increased in brilliancy by the month of August.

| Berlin Mean time. | R.A.    | D. 3      | Brightness<br>(brightness at time<br>of discovery = 1). |
|-------------------|---------|-----------|---------------------------------------------------------|
|                   | h. m.   |           |                                                         |
| May 19.5          | 6 30.9  | + 68 49.4 |                                                         |
| 28.5              | 34.34   | 53.1      |                                                         |
| 27.5              | 39.49   | 59.8      |                                                         |
| 31.5              | 45.55   | + 69 8.4  |                                                         |
| June 4.5          | 52.57   | 19.2      | 3.8                                                     |
| 8.5               | 7 0.57  | 31.6      | 4.5                                                     |
| 12.5              | 10.0    | 45.1      | 5.5                                                     |
| 16.5              | 20.17   | 58.1      | 6.7                                                     |
| 20.5              | 31.57   | + 70 9.3  | 8.4                                                     |
| 24.5              | 45.8    | 16.3      | 10.6                                                    |
| 28.5              | 59.59   | 15.2      | 13.6                                                    |
| July 2.5          | 8 16.36 | 0.7       | 17.8                                                    |
| 10.5              | 56.47   | + 68 15.0 | 32.3                                                    |
| 18.5              | 9 35.50 | + 62 45.2 | 64.8                                                    |
| 26.5              | 10 8.57 | + 47 10.9 | 146.3                                                   |
| Aug. 3.5          | 21.30   | + 8 52.7  | 245.0                                                   |
| 11.5              | 10.55   | + 28 17.2 | 130.8                                                   |

#### SOCIETIES AND ACADEMIES

##### LONDON

Royal Society, May 7.—Note on some Winter Thermometric Observations in the Alps, by E. Frankland, F.R.S.

During the past winter the author spent a fortnight at the village of Davos, Canton Gränbünden, Switzerland, and had thus an opportunity of experiencing some of the remarkable peculiarities of the climate of the elevated valley (the Prättigau) in which Davos is situated. The village has of late acquired considerable repute as a climatic sanitarium for persons suffering from diseases of the chest.

\* NATURE, vol. viii. p. 342.



*"Proposed Special Scientific Collections"*

"Although we think it desirable that Scientific Museums and Collections should be maintained in the Universities to an extent which would render them available for original research, as well as for the purposes of education, we do not attach the same importance to this point as to the preceding, because museums and collections have been formed and will be formed in other places than in Universities, whereas laboratories adapted for the instruction of students in the methods of scientific investigation are not likely to be founded except in connection with educational institutions; and although it is a disadvantage to a scientific man not to have all the collections that he desires immediately at his hand, yet, considering the proximity of the Universities to London, it cannot be said that this disadvantage amounts to more than an inconvenience.

"We also are of opinion that it is very desirable that such more extensive collections as may be formed in the Universities should, as far as possible, be kept separate from the more limited collections intended for educational purposes. A Museum may be very easily made too large for these purposes, and instead of giving the student clearer ideas, may serve to confuse him.

*"Proposed Doctorate in Science"*

"We have already referred to the possibility of instituting Higher Degrees, to be conferred upon students, not in accordance with the results of an examination, but upon their giving proof of capacity for original research. The evidence of Dr. Frankland and of Sir William Thomson, which we have already quoted, and to which we might add that of the late Prof. Rankine, appears to us conclusive upon the point that there is a real danger in the examination system; and in our opinion this danger might be guarded against by instituting a higher degree in Science, the obtaining of which should be regarded as a great honour, and which should not be awarded except with reference to original work. The plan of requiring from a candidate for the Doctorate in Science a dissertation embodying an account of some original research of his own is strongly approved by such competent witnesses as Dr. Siemens, Dr. Carpenter, and Prof. Frankland. This plan has been adopted in several of the German Universities, and has now become the established rule in France."

*METEOROLOGICAL CONFERENCE AT LEIP-  
SIG DURING AUGUST 1872\**

OF the Congresses which have recently been held, none were more urgently called for than an International Congress of Meteorologists. Doubtless even under the diverse systems of observation which have been in use at national observatories and among meteorologists of different countries, large and valuable contributions have been made to Climatology and other departments of Meteorology. We need only refer to the various charts which have been published, showing the geographical distribution of atmospheric and oceanic tempera-

\* Report of the Proceedings of the Meteorological Conference at Leipzig. Protocols and Appendices. Translated from the Official Report, Appendix to Vol. vii. of the "Zeitschrift für Meteorologie." Published by the authority of the Meteorological Committee. London, 1873.

ture, of atmospheric pressure, of humidity, of prevailing winds, and of rainfall, and to the enormous amount of materials now being amassed, illustrative of the nature and course of storms, to show the important results which have been obtained. It must, however, be confessed that, as respects nearly the whole of this information, it can be regarded as valuable only in the sense of its being sufficiently approximate so as to meet the requirements of some of the more pressing practical questions of the science, and not because it is precise.

It is when we attempt inquiries into such questions as the diurnal and annual march of the different meteorological elements, and the relations of these elements *inter se*, and of weather on a large scale, that the general unsatisfactoriness of the systems by which observations are made in different countries comes to be forcibly felt, owing to their want of precision and uniformity. The want of uniformity is most conspicuous as respects temperature, humidity, and wind—or just those fundamental facts which must be scientifically observed and discussed before we can hope to solve the problem of weather changes.

In order to bring about a greater uniformity of procedure in different countries, it was proposed to hold a Meteorological Congress at Vienna in 1874. In June last, Bruhns of Leipzig, Wild of St. Petersburg, and Jelinek of Vienna, issued an invitation to meteorologists to attend a preliminary conference to be held at Leipzig in August, for the purpose of preparing the programme for the Vienna Congress, to instigate preparatory experiments on some of the more important questions, and thereby render it possible for the Congress to arrive at immediate conclusions on many points. The Conference was thus only consultative. Accompanying the invitation were a series of twenty-six questions, which it was proposed to submit to the consideration of the Conference.

Upwards of fifty persons attended the meetings of the Conference, which lasted three days. The opinions of the different speakers on the points raised by the 26 questions are detailed in the pamphlet before us, which contains also the written opinions of 14 meteorologists who were unable to be present, including the well-known names of Dove, Ribenson, Mohn, Mühry, and Wolf, as well as the results of the deliberations of the French meteorologists at Bordeaux in September. The subjects treated of may be conveniently classed under the heads of instruments, their position, the methods of discussing, publishing, and utilising the observations.

*Barometers.*—To those who have attempted to discuss weather, it is well known that nothing exact or satisfactory need be looked for in the result, unless observations from numerous barometers well distributed be available. It is thus desirable that barometers be procurable at a moderate price for stations of the second order. Are Board of Trade barometers—barometers fitted with a float—or aneroids, suited for such stations; or is there any other cheap form of barometer that would serve the purpose? After a lengthened discussion it was referred to Dr. Hann of Vienna to prepare a report for the Vienna Congress. The most diverse opinions were expressed regarding the aneroid, arising probably from the experience of the different writers and speakers—some aneroids going well for years with no permanent alterations occur-

over



ring in their indications; some going well so long as a small range of pressure is recorded, but undergoing alterations after every great barometrical depression; some constantly altering in one direction, others in either direction, &c. Since, however, it can be safely affirmed of no aneroid, how good soever it may have proved itself to have been, that it will continue to indicate correctly for even a brief time to come, the Conference came to the sound conclusion that the aneroid should not be used instead of the mercurial barometer, but only as an interpolation instrument, to fill up blank when the mercurial barometer is out of order, or when it cannot be observed on board ships in rough weather.

*Maximum and Minimum Thermometers.*—Rutherford's minimum spirit thermometer was regarded as satisfactory. On it being pointed out by several members that this thermometer is liable to go out of order by the spirit evaporating and condensing in the upper end of the tube, Ebermeyer, of Aschaffenburg, stated that this objection could be removed if the tube were at its entrance into the bulb inserted nearly up to the inner side of the bulb. We commend this suggestion to opticians; for if Ebermeyer's experience be confirmed, a source of serious and not infrequent error will be removed. On the other hand the performance of no *maximum thermometer* was considered to be so satisfactory that a uniform construction could be generally recommended; and the opinion was expressed that it was very desirable that a trustworthy maximum thermometer was devised, not liable for instance to have the mercury disturbed during high winds like Negretti and Zambra's, or the index portion go out of order as Rutherford's or Phillip's.

*Instruments for Radiation.*—Mr. Symons, who has paid much attention to this question, has been requested to give a report to next Congress on the modes of observation adopted in England for radiation. But it must be confessed that the methods of observation in this important inquiry are still in a very primitive state. Mr. Salt well pointed out that at present the results obtained with different instruments were not comparable with each other, and one hardly knew with the instruments now in use what was really observed.

*Hygrometers.*—Since the dry and wet bulb hygrometer is not trustworthy at low temperatures and in cases of extreme dryness, and the hair hygrometer fails also at the dew points, and since there is no hygrometer yet devised, at least for regular observations at stations, which gives approximately exact results as to moisture in all cases, it was recommended to make further experiments and collect the experience of meteorologists on the subject. From the favourable opinions expressed by Wild and others of the action of the hair hygrometer, further experiments with this instrument are very desirable, so that it might be made available for more accurate observations on the hygrometry of the air at temperatures below the freezing-point than the dry-and-wet hygrometer admits of. Another desideratum is an extensive series of experiments with Regnault's hygrometer in conjunction with the dry-and-wet bulb hygrometer in dry hot climates such as N.W. India, for the purpose of ascertaining how far the readings of the dry-and-wet bulbs can be used as data from which the dew-point may become known; and determining the requisite data for the correction and com-

pletion of the present hygrometric tables, particularly at points below freezing, and at high temperatures combined with great dryness.

*Wind.*—Curiously enough, the question of proper instruments for measuring the velocity and force of the winds does not seem to have been under discussion, even though it is one of the most important and pressing questions of the science. Anemometers, both for velocity and pressure, are indispensable to properly equipped observatories. Now it cannot yet be said that the anemometers for velocity give quite correct indications that they are comparable, *inter se*, and that we have a practicable means of ascertaining their errors from time to time.

Equally remarkable was the omission in the discussions, to consider what are the required conditions which anemometrical stations ought to fulfil, so that the instrument shall indicate the true movement of the air over the region where it is placed; or, if this cannot be accomplished, what observations should be instituted in order to ascertain how far the direction of the wind is deflected by the physical configuration of the surface, and its force diminished (or in rare cases accelerated) as compared with the general movement of the air over the place.

Pressure anemometers at a moderate cost are a great desideratum. Little satisfactory is known of the relation of pressure to velocity.

*Rain.*—The Committee proposed that a report of all the experience regarding the position, size, height above ground, and time of reading the rain gauge which has been yet gained should be prepared for the Vienna Congress. For the preparation of such a report the great storehouse of facts at hand are those collected by Mr. Symons in the successive parts of his "British Rainfall" and "Meteorological Magazine," which the members of the Congress would do well to consult.

*Evapometer.*—The present state of the evapometer is one of the least satisfactory of all the meteorological instruments. Considering the importance of the drying property of the air in relation to meteorology generally, but especially as one of the most important constituents of climate, it is to be hoped that some method will be devised by which results, at least roughly comparable to begin with, may be obtained.

The difficult, but vital question of the position of the thermometer does not seem to have been faced by the conference. It is earnestly hoped that the Vienna Congress will not shirk this question, but will seriously discuss it and arrive at some decision, or suggest some steps to be taken, that will ultimately lead to the degree of uniformity which is so imperatively called for. Till this be secured, the expensive systems of horary or continuous registration of temperature carried on at the great observatories of this and other countries, cannot supply the data for the determination of temperature "constants," seeing that they are incomparable with each other, as well as with the observations made at those numerous stations of the secondary order to which we must look for the working out of the great national question of local climates in their bearing on the health, productions, and commerce of the country. The question would be of comparatively easy solution were it possible, in the interests of cosmical inquiries, to ignore the past. But it is essential in the



WHY SHOULD YOU SUFFER  
WITH  
**HOT DRY AIR**  
IN YOUR  
DWELLINGS?

When, by attaching to your Registers  
and Stoves,

**Dr. Colburn's**  
POROUS  
**EVAPORATOR**

*You can so thoroughly moisten the Air in your  
Apartments as to render it pleasant and  
Summer-like.*

---

Hot, dry air will have moisture, and if not provided by some evaporating process, will produce serious effects upon the human system. Hence, the headaches, catarrhs, bronchial and lung complaints, so prevalent in the winter season.—The Porous Evaporator has been thoroughly tested, and its merits, as a sanitary agent, admitted by our most eminent physicians.

---

*The Evaporator is being introduced into this City, and many well known Citizens are using it. Send for a Circular of Testimonials, and Explanations; or step in and see it in operation, at*

**610 Chestnut Street.**

---

**GRANVILLE MALCOM,**

Manufacturer.

 Prices range from \$3.50 to \$5.







# How to Understand the Weather.

THE following interesting and valuable article from the *Galaxy Magazine*, is reprinted for the purpose of showing the readiness with which the principles set forth by Prof. Blasius in his recent work, "STORMS: THEIR NATURE, CLASSIFICATION, AND LAWS," may be practically applied by the general reader to the ordinary purposes of every-day life.

To those whose occupations take them much out of doors, a knowledge of what weather is to be expected is of great importance to health and comfort; to the farmer or the mariner it is, in addition, a safeguard against loss. A careful reading of Prof. Blasius's work will give to all such the principles by which the phenomena of weather may be interpreted, and a knowledge obtained in advance of what changes are to be looked for. The natural phenomena of the weather, such as clouds, temperature, the wind, etc., may be observed by all with sufficient accuracy for practical purposes, if not for scientific research.

The value of Prof. Blasius's principles in applying the data furnished by the Signal Service "probabilities" to *particular localities*, will be seen from the following article, which, it may be well to state, was written of his own motion by a gentleman unknown to either author or publishers of the book, and without their knowledge.

## WEATHER WISDOM.

(Reprinted, by permission, from the New York "Galaxy," for November, 1875.)

The calling of the weather prophet has always been one of great popularity. Weather predictions have been common from the earliest times, and the faculty of weather wisdom is, curiously enough, generally in the inverse order to the civilization and education of its possessor.

The roving Arab and Indian, the Tartar of the Steppes, the Bushman of the African plains, the illiterate huntsman and sailor, the farmer—all these classes of men are far more likely than a college graduate to answer with correctness the question, "Will it rain to-morrow?" Living an outdoor life, depending on fine weather for comfort, and sometimes for existence, their minds are early turned to observing the signs of the weather; and experience, observation, and tradition unite to teach them, without understanding the causes of phenomena, the main laws of nature affecting the atmosphere.

The old sailor, the farmer, and the hunter will often predict a storm many hours

in advance, from certain appearances in the sky which they have always observed to announce one. The book-man, on the other hand, though he may have gone through a complete course of physical geography and meteorology, and can talk learnedly about the cyclonic theory of hurricanes and typhoons, rarely makes this knowledge of much practical service to himself and his neighbors in the examination of the weather at home. He hears an old farmer or sailor say, "Looks showery this evening. Going to have rain." He looks around and sees a pretty clear sky. What clouds do exist are light and feathery, and he smiles to himself, thinking, "What does *he* know of the laws of storms or the cyclonic theory?" As the evening advances the clouds disappear, and the stars shine out brilliantly. He goes to bed, more than ever satisfied that the rude weather prophet was wrong. About an hour before dawn he is awakened by the sound of rain, and finds that his unlearned



friend was right after all. A heavy shower has come down, and lasts, with intervals, the whole of next day. The weatherwise farmer had observed in the clouds signs which the learned collegian could not interpret. He understood them partly from observation, partly from the traditions of others before him. Without knowing the causes or realizing his own process of reasoning, he felt that rain was coming; and the result justified his traditions.

Within the last century meteorology, or the science of weather wisdom, has been followed with great industry and perseverance in many parts of the world; in none with better results than in the United States. Many causes have contributed to this. The rapid increase of facilities of travel has led scientific observers to the tropics, where the laws of storms, large and simple, and less modified by variations than in the temperate zone, are more easily studied.

In the science of meteorology, however, as in other sciences, the synthetic method has too often been followed instead of the analytic, tending to constant changes of theory, and a consequent delay of real progress. The synthetic method is nearly always followed under the shadow of a great name, and all its errors proceed from that old logical fallacy, the *argumentum ad verecundiam*, or "appeal to modesty." The true student of science stands ready, like Tyndall, to abandon any and all theories, one after the other, when they are contradicted by newly found facts. Theory in his view is only fancy, excusable but not commendable, save as an incentive to observation and record of facts. He makes a clear and constant distinction between *laws* and *theories*. Kepler's laws of the orbits of planets and Newton's laws of the action of gravity were discoveries, and not theories. Those philosophers stated facts. That their discovered laws might be correct while their theories in other respects might be incorrect is evident, but the mass of mankind confounds theory and law, giving to both an equal weight. So long as this confusion affects scientific investigation it retards it, and such has been the case with meteorology, among other sciences, for many years.

Early in the present century a certain Colonel Capper started a theory that all storms were circles of greater or less diameter, moving around a centre, which also advanced in a certain path. The theory was founded on the observed whirling effects of certain tornadoes. This theory—the rotary—was developed by Piddington in his "Laws of Storms" and "Sailor's Horn Book," and later by Thom, Reid, Redfield, Dove, and others, the name cyclonic being given to it, and all storms being denominated cyclones of greater or less diameter. This theory has largely influenced navigation ever since, and is at present the one semi-officially adopted by meteorological bureaus, as shown by the name "cyclone" used in their reports of storms.

A second theory, also founded on observed facts, has been developed in later times by Professor Espy. It is known as the "inblowing theory." Admitting the same centre to the storm, Espy ascribes it to a heated column of air rushing upward and leaving a vacuum, to which all the air in the vicinity rushes, blowing in from all quarters to a common centre, not whirling around it, as asserted by the cyclonic theorists.

Both parties admit the centre, and Espy explains it as being a column of heated air. The cyclonists, headed by Professor Dove, of Berlin, refer it to a meeting of opposing currents, one of which shifts around the western edge of the other and produces a whirling movement, which increases till it equals the combined velocity of both currents. This, in the northern hemisphere, produces, according to them, the hurricane or storm rotating in the direction opposite the hands of a watch; in the southern hemisphere the same storm, with the opposite movement. These clashing theories have had their fierce advocates. Meanwhile the United States Signal Service, not decidedly committed to either, but inclined to the cyclonic theory, has been accumulating a store of meteorological facts, denied to any other nation.

In the course of all the weather observations so far existing in the world, only one general and always reliable law of storms has been discovered. It was first



announced by Professor Buys-Ballot, of Holland, and is known as "Ballot's law." It relates to that great weather indicator of modern times, the barometer, and its relative pressures. Ballot's law is: "*The wind always flows from the place of highest pressure to that of lowest, turning by the rotation of the earth to the right on the northern hemisphere, and to the left on the southern hemisphere.*" The first part of this law—that in italics—has been found to be absolute in every case; the second part is liable to very puzzling exceptions, which still leave the whole science of weather wisdom liable to mistakes in its predictions, especially in the summer. In the winter reports of the United States Signal Service the coming of storms is generally predicted with singular accuracy, its rate of progress and its rain or snow area mapped out in advance for as much as three days in some cases. The method of prediction is by no means complicated, depending on Ballot's law and its observed corollary, that the rain area *is found to surround the area of low barometer, and to be included by the lines of equal barometer* (called isobars), *which define the edge of the high barometer area.* A familiar illustration will give an idea of the *isobars* and *gradients* on which modern weather wisdom relies in its predictions. The area of low barometer will then represent a little pool in the bottom of a large valley, that of high barometer a table land above and surrounding the valley, the gradient will be the inclination of the slope of the valley's sides, the isobars will define the shape of the edge of the valley and that of the little pool. The whole valley will be the rain area, the pool the centre of the storm. Let pool and valley move together and you will have a perfect idea of the winter storm, the table land being the viewless air, the valley being full of clouds, and rain, and snow. The shapes of valley and pool are similar, and reveal another law. They are always irregular ellipses, and almost always advancing in the direction of the short axis, as one might roll an egg. The pool is always much nearer the rear of the rain area than its front. We find the illustration of this law in every winter storm. It takes a long time to brew. Its crisis

being past, it clears up much more quickly than it clouded over. The size and consequent length of the storm varies from three to six days, but the proportion of its centre to the rain area remains practically the same. The larger the pool (area of low barometer) the longer the storm and the more extensive the rain area.

In summer the recorded storms are of different character. Their extent is smaller, the area of low barometer less, the gradient (slope of the valley) steeper, the advance more rapid, the destructive effect greater, tornadoes and waterspouts not infrequent, and last, but not least, the barometer gives less warning and weather predictions are less reliable. The signal service, which in winter is so sure, becomes more liable to mistakes in summer. Local storms are more frequent, and local storms receive little notice from the central office beyond a record of their passage.

It is in this state of things that the weather wisdom of the old sailor and farmer, that of the Arab and Indian, has come at length to our aid; and it is to a member of that philosophic German nation, whose patience of record and classification has given us so many discoveries of value in late years, that we are indebted for the assistance. Mr. William Blasius,\* formerly professor of natural science in the Lyceum of Hanover, and a resident and citizen of America for a quarter of a century, has just given to the world a book on storms and the means of predicting the same, that promises to overcome many of the difficulties now besetting meteorology, and to give us a really valuable set of laws, as well as a mere theory of explanation. Like all theories founded on truth, it is extremely simple, and only needs to be fully stated to be understood. That it will be fully accepted for some time by meteorologists wedded to the cyclonic or inblowing theories is improbable, but that it takes away many of the difficulties in the way of weather prediction is certain. The facts recorded by Mr. Blasius may be tested by any one, and they turn out to be exactly

\* "Storms: their Nature, Classification and Laws, with the means of Predicting them, principally by their Embodiments, the Clouds." By William Blasius. Philadelphia: Porter & Coates, 1875.



those applied by farmer, sailor, and savage since the world began. The German weather prophet points them out in simple language so that all may read them, and under his guidance any person of intelligence may become a fairly reliable weather prophet without the aid of a barometer, by the use of eyes and reason; while the addition of this method to the present use of barometer and thermometer in the Signal Service promises to double its efficiency.

Briefly stated, the Blasius laws are as follows:

I. All storms are the result of opposing currents of air—one cold, the other warm; or one polar, the other equatorial.

II. Most of the winter storms are produced by the warm equatorial current moving north and climbing over the cold polar current. These all come from the southern semi-circle of sky.

III. Most of the summer storms are produced by the cold polar current moving south, pushing the warm equatorial current before it. These come from the northern semi-circle.

IV. The place of meeting of the two currents is the area of calm and of low barometer. The opposing currents neutralize each other, produce a calm, heat the air by friction (and perhaps electricity), and the barometer falls.

V. The region of high barometer is that of either current before it meets opposition. The region of highest barometer is that of the coldest current, because the air is heavier than that of the warm current, and exerts more pressure.

VI. The gradient is the slope of one current over the other. In the winter it is very gradual, because the warm current is the aggressor, and slopes far over the cold one. In summer it is steeper, because the cold current banks up against the warm one, and cannot climb over it, for its great weight. The rain area is all under the slope.

These laws he establishes from the following observed facts:

The evidences of opposing currents are clouds. There are no storms (except in deserts) without clouds. They form whenever a warm current meets a cold one, which condenses its vapor, or when a warm

current rises perpendicularly to a cold region. The equatorial current, sloping far over the polar, as in winter, develops its own vapor in thin *stripes*, which are the precursors of a winter storm. The polar current, pushing back the equatorial, as in summer, condenses the vapor of the latter in heavy *masses*, the *cumulus*. If when we have a gentle north wind we see thin stripes rising in the south and climbing northward thicker and broader, as in winter, we know that a northeast storm is coming. It may oscillate back before reaching the zenith, in which case it is put off for twelve or twenty-four hours, but is sure to return. If the storm passes over us, comes back and clears off *in the north*, our next change will come from the south as before. If it passes entirely over and clears *from the south*, our next change will be *from the north*.

If, in summer, we see a long, low bank of cumulus cloud rise *in the north*, when the wind is *southerly*, and advance slowly against the wind, a southeast storm is coming. The less wind there is with us the more probably will it burst over our heads. If there is a dead calm, so much the more probability of the storm being near us. If the weather is very sultry as well as calm, the storm will be very heavy. The heat and difficulty of breathing show violent opposing currents, and air in a state of compression in the calm region. Should any local circumstance suddenly disturb the equilibrium, the local storm will probably be very violent. Such storms often assume the character of tornadoes, and are found to follow nearly the same tracks year after year, indicating a probably local origin. This origin Professor Blasius has discovered, in the case of the only American tornadoes that have been scientifically and fully examined, to be the *configuration* of the ground. They never arise on plains. Their place of formation on land is either a ravine cut in a plain by the sudden turn of a river, or the edge of a sudden descent or bluff. At sea it is always near an island, or at the edge of a warm oceanic current, such as the Gulf Stream, producing a heated column of air in the midst of cooler air. In all reported cases the tornado moves *in the diagonal of the two opposing*



*currents of air*, zigzagging from side to side and forming whirls at intervals. It gathers strength at every ravine, and is apt to disappear when on land over extensive plains, frequently coming down again at a fresh ravine, to run a new course of destruction. Ocean tornadoes, as we can see for ourselves in every school physical geography with a meteorological map, follow the directions at the edge of the warm currents, and skirt the coasts of continents, being modified by the conformation of the earth on a larger scale. Thus the West Indian and Mauritius hurricanes follow at a distance the lines of the eastern coasts of North America and Africa, and the Asiatic typhoons take a different direction entirely, some following the southern coast of Asia into the Bay of Bengal, others tearing along the Chinese coast with the Kuro Siwo, or Japan current—literally Black Stream—to Japan. In each case they keep off the continent, but follow the line of the coast.

With these larger storms, however, it is not our purpose to deal at present. However interesting to a student, they are not so valuable to us as the answer to the query, "Will it rain to-morrow?"

We have a picnic planned, or we are going fishing, we propose a sail or a riding party, if it is summer. We want to skate if it is winter. An important question to all of us is, "Will it rain (or snow) to-morrow?"

The signal service answers our query for to-day with general accuracy, but its warnings often come too late. If the horses are at the door, and the heavens pretty clear, "Old Prob." is rarely consulted; or if he is, we agree to risk it, even if he prophesies rain. Besides this, "Old Prob." is very large in his generalizations, and unsatisfactory as to local storms. He lumps all New England together, and all the Middle States on the Atlantic coast in another class, and says for instance, "Higher, followed by falling barometer, southeasterly to northeasterly winds, with cool, increasingly cloudy weather, followed by light rains." This was the prediction for New England and Middle States for July 2, 1875, and it must be confessed that it was somewhat vague

for local guidance, at the same time that it contained valuable information to those who knew how to read it. The part about the barometer was Greek to many, nay, most of its readers, and the latitude of wind spread over a whole quadrant of the heavens. The "increasingly cloudy weather, followed by light rains," was plain enough, but the interesting questions were, Where would the rain fall? When would it begin? Would it be local or general? and How should we recognize its coming a few hours previous? The writer has taken the present for a test case of Blasius's laws, as occurring during the writing of this article, the locality being Westchester county, within fifteen miles of New York. It is in these circumstances that Blasius comes to our aid and teaches us how to interpret the language of the signal service, which is general, and to make a local application, as well as to make pretty safe local predictions, without the aid of any signal service or barometer at all. "Higher, followed by falling barometer, southeasterly to northeasterly winds," is the information; the rest is the corollary. The information means a cool current blowing over us. As long as it lasts we are in no danger of rain, in summer. It comes from the sea, which is cool, and moves over the land, which is warm. What vapors it carries will be held in suspension. Its coming from the east shows that it is normal and natural.

The "falling barometer" means a check of this cool current, by meeting a warm one. At the place of meeting the warm current will condense its vapor on the cool one. The result will be a mild form of storm. It depends on circumstances which current takes the aggressive, and where. If the northern pushes back the southern, it will make a southeast storm to all places south or southwest of the place of meeting, with warm, sultry weather and *cumulus* cloud, dark and threatening. If the warm current takes the aggressive, we who live north or northeast of the place of meeting shall first see faint stripes of *stratus* cloud in the southwest, our wind being northerly and easterly. As those stripes advance upward our wind will become fainter and more fitful, and when they cross the zenith



our barometer will begin to fall. When they cover the sky the rain will fall, and we shall have a mild form of the northeast or characteristic winter storm. It will be mild, because the difference of temperature of the two currents will be smaller than in winter.

The question is, How shall we know where the place of meeting will be, and whether we are north or south of it? Here the German professor comes to our help. If our wind is north and east and we see the stripes in the southwest, we are north of the place of meeting, and a northeast storm is coming toward us. If the stripes stop and go back, that storm is somewhere south of us, and will come back to-morrow at latest. If it comes back and again retires to-morrow, it will again return in twelve hours at latest. At all events, with our northeast cool wind, our next change will come from the southwest, and we shall have at least six hours' warning by stripes of cloud in that direction. Till it comes from there, we shall have fine weather. When it has come, if it clears in the south we shall have warm weather, for the warm current has driven the cold one away to our north, and will blow over us. If it clears in the north we shall have cool weather again, for the cool current has driven back the hot one. This is very improbable, however. If it does take place, the storm will at once change its character and the clouds with it. The light gray *stratus* will become heavy black *cumulus*, the contest will be violent and tornadoes probably at the place of meeting. So much for the possibilities. Let us come to the actual facts on the 2d of July, 1875. It was the first cool, delicious day after a long and sultry season of heat. Local storms, with thunder and rain, had brewed up and burst over Westchester county and New York city almost every evening, leaving the air hotter than ever. The wind remained southerly and every storm moved against it. The writer, being anxious to test the truth of Blasius's laws, watched all these storms. As the German predicted so it came to pass. If they gathered in the south, it was over Long Island sound, and they moved south in every instance. If they were in the north, it was over the

Hudson, and they were sure to move south and involve the place of observation. If in the west, they were over New York bay and moved south, we just grazing the eastern edge. From the northeast and east they never came, because there was nothing but land there, and the cold air over water was necessary to condense them. At last came the news from "Old Prob." of "an area of low barometer" advancing from Dakota towards Minnesota and the lakes. Then came news of a tornado at St. Paul, Minnesota. That settled the character of the storm. It was the southeast variety. In other words it was the polar current advancing to restore the equilibrium of the atmosphere in the northern hemisphere. The same day came news of a very similar tornado in Europe, passing through the cities of Buda and Pesth, in Hungary, on almost the same parallel of latitude as St. Paul, Minnesota. After the tornadoes the change of weather was rapid. The area of low barometer (the meeting place of the currents) enlarged, advancing with much greater speed. Instead of a storm it became a sudden change of weather; for slowly advancing storms indicate a violent struggle of opposing winds, which now no longer existed. The polar current drove back the equatorial current to the sea coast, and cool weather and high barometer prevailed for several days. The northeast wind, which, deflected by the Rocky Mountains, had become a northwest wind in Dakota, revealed its polar origin by its direction in New England. Under these circumstances the next change must be an aggression from the equator to restore the equilibrium, and such was the case on the 2d of July, 1875.

In Westchester county the following were the conditions: At 11 A.M. clear sky, wind east and northeast, varying to southeast at intervals. On the northeast horizon (to windward) a few light *cumulus* clouds, disappearing as they climbed higher. In the southeast a few stripes of *stratus*, irregular and at intervals. Below them a low, faint bank stretching out to sea, but clear and high, the sea plainly visible. The stripes of *stratus* were slowly dissipating. Under Blasius's rules, the indications were in favor of fine



weather for that locality, the place of meeting being further south. At 3.30 P.M. the conditions were nearly the same. The *stratus* in the southwest had disappeared; the *cumulus* in the northeast was the same in character, but still fainter. While "Old Prob." might be correct to the south of us, Blasius had supplied in our place of observation the local deficiencies of the general law of the weather we were to experience. The northeast storm had oscillated back, with a probability of return the next day, as far as we were locally concerned, and our weather wisdom, or rather that of Blasius faithfully applied, had proved entirely satisfactory. The question "Will it rain to-morrow?" was answered, "Probably yes, and certainly more or less cloudy weather. If not to-morrow morning to-morrow night, a change of weather to warm and wet."\*

We have condensed these few remarks on the contents of a very valuable book for the benefit of the readers of the "Galaxy," the question with which we open being one of every-day occurrence. To a pleasure-seeker by the seaside it is often the only topic of interest, and the German professor is the first man who has suggested an answer which can be given by any man who takes the trouble to read a very pleas-

ant book. Parts of it require harder study than most summer loungers feel inclined to give it. These parts contain the reasoning as to general laws.

The chapters containing the laws themselves, especially Chapters III and X, are delightful and interesting reading, and their precepts may be tested by any one. As far as our own locality is concerned we have found them in all cases reliable, in that most difficult time of year for weather prophecies, the summer. Whether in hot, sultry weather, or in cool, breezy weather, the two forms of clouds, *cumulus* and *stratus*, have been infallible guides, and their rate of progress is a sure test of coming weather. The very shape of the "mare's tails" in the sky, as interpreted by Blasius, we have found reliable. If the end curls up toward sunset, rain comes before morning. If down, the weather will be fine. If *cumulus* gathers in the north and rises, rain will very probably come on us before night. If it rises in the south it is nothing to us. If stripes rise in the southern sky and climb north, our next change will be from their quarter. All storms come against the wind prevailing at the time, if the weather be fine, and all change the wind at their passing and after. The stripes of the northeast storm and the banks of the southeast storm are visible before the barometer falls, and give quicker warning, while for local purposes they are superior as indicators. The understanding of Blasius's laws gives a new significance to the general predictions of "Old Prob.," when we know that low and high barometer are only *effects* of the meeting of currents, not *causes* of storms. That the German professor's laws are universal and infallible in all climates may or may not be true. That they offer themselves readily to test will be seen, and if they tend to make meteorology a popular science we shall all owe a deep debt of gratitude to Prof. William Blasius for teaching us how best to answer the question, "Will it rain to-morrow?"

F. WHITTAKER.

\* The actual changes in the weather turned out as follows: July 3d. Morning opened clear and bright. Heavy clouds gathered all the morning, and there was an evident effort to rain. During the evening of the 2d the barometer fell, and rose again in the night. The clouds gathered thicker and thicker, the wind having changed to southerly, warm, faint, and damp. About 3 P.M. it cleared and became very hot, with south wind. On Sunday, July 4th, it opened hot, same wind, and clouded up toward night, when it rained toward dawn. July 5th opened wet, and cleared up very hot. From thence till Thursday, 12th, a succession of hot days, with the same series of local storms moving south. On Thursday, 12th, a change to cooler weather exactly similar to the previous Friday, 2d. Afterward a repetition of the same phenomena, in the average of two days cool to five or six hot and wet. The local storms showed themselves as before in the cumuli, the gradual change of weather without rain in cumulus and stratus at opposite quarters of the heavens.



# STORMS:

## THEIR NATURE, CLASSIFICATION, AND LAWS,

WITH THE MEANS OF PREDICTING THEM,  
PRINCIPALLY FROM THEIR EMBODIMENTS, THE CLOUDS.

By WILLIAM BLASIUS, formerly Professor of the Natural Sciences in the Lyceum of Hanover. Profusely illustrated with Colored Plates, Maps, Diagrams, and Cuts. Crown 8vo, cloth, extra, \$2.50.

### OPINIONS OF THE WORK:

"This book shows a large amount of observation and labor, for which meteorologists may well thank you."—Capt. HENRY TOYNBEE, *Marine Superintendent, Meteorological Office, London.*

"I have had no leisure to study your work with the care and attention which it evidently merits, but from what I have already read of it, I have no hesitation in saying that, in my opinion, it is a valuable production; my intention is to review it as soon as possible. I am glad to find that you advocate some views that have been held here for many years."—Prof. C. MELDRUM, *Director of the Meteorological Observatory, at Mauritius.*

"That you introduce the cloud-forms into practical meteorology, is certainly very good."—Prof. H. MOHN, *Director of the Meteorological Institute, Christiania, Norway.*

"Your excellent book on storms is of the highest interest to me. . . . The Bavarian Government intends to establish a Meteorological Central Institute and to connect with it a Signal Service. Lamont, Lommel, and myself have prepared the plans. At the time of its establishment, I shall take the liberty of consulting you and make use of your rich experience. I long for the German edition of your magnificent work."—Prof. Dr. EBERMAYER, *Aschaffenburg, Bavaria.*

"We need more light upon meteorology to clear up its great difficulties, in spite of all that Redfield, and Espy, and Reid, and Dove, and the Government meteorological bureaus have done. My feeling now is, that you have discovered the key to most of its more practically important mysteries. I trust that you will prosecute your observations and give our marine some trustworthy sailing directions in cases of tornado; for the English confess that the Reid and Redfield directions are utterly uncertain in practice."—J. P. LESLEY, *State Geologist of Pennsylvania, Professor in the University of Pennsylvania, Secretary of the American Philosophical Society, etc.*

"Prof. Blasius, has, I believe, found the true theory of storms."—JOHN GUEST, *Commodore, U. S. Navy.*

"The most valuable and satisfactory work on meteorology that has appeared for many years."—Prof. V. L. CONRAD.

"Prof. Blasius has made a most valuable contribution to our knowledge of the movements of the atmosphere, and has done much to improve our acquaintance with that mythical personage, 'The Clerk of the Weather.'"—Prof. S. P. SADTLER, (*University of Penna.*) in the *Penn Monthly*, Phila.

"It may at least be questioned whether this method of simultaneous observation at stated times of the day is likely to be as fruitful as that adopted by Prof. Blasius."—(An editorial in the *New York Times*.)

"We think this work will prove a valuable contribution to meteorology."—*Moore's Rural New Yorker.*

"The work is a timely and valuable contribution to the science of meteorology."—*Inter-Ocean*, Chicago.

"It deserves a place among the choice reference-books of ship-master, yachtman, and in fact all who have to look to the sky for weather warnings. Chapter X is worth the price of the whole work."—*Nautical Gazette*, New York.

"It would be an intensely interesting labor to go carefully over Prof. Blasius's book and reduce to the simplest possible form the nature and amount of its contribution to our common stock of knowledge. . . . One mastering the knowledge conveyed in this volume will be in better mood to comprehend 'Old Prob.' and to sympathize with his daily bulletins; may, indeed, in a small way, become a sort of prophetic probability himself."—*The Congregationalist*, Boston.

"Aside from all disputed points, his practical remarks on weather signs are of the utmost importance, and are so simple that they may be easily verified. . . . Those who are interested in meteorology will find the book of great value, not only for the facts it contains, but also for what it suggests in the matter of future investigation."—*Boston Gazette*.

"To the meteorologist, Dr. Blasius's studies of the characteristics of storms are excellent as local studies, and some of his descriptions of the various kinds of storms are most admirable. . . . In a general way, we may say, that this book is a valuable one; its studies of local tornadoes and storms would alone make it so, and its collection of the results of the work of such men as Buys-Ballot, Mohn, and others renders it of much interest."—*Atlantic Monthly*.

*For sale by all booksellers, or will be sent, postpaid, on receipt of price.*

PORTER & COATES, PUBLISHERS,

No. 822 Chestnut Street,

PHILADELPHIA.

No Dwelling House, Public Building,  
 CHURCH, SCHOOL,  
 HOSPITAL, BANK,  
 Or other Building heated by furnaces, stoves or steam pipes,  
 should be without

DR. COLBURN'S  
 POROUS EVAPORATOR

FOR  
 Supplying Moisture to Heated Rooms.

Patented January 22, 1861;

Reissued April 2, 1861;

(To cover all porous materials.)

Extended January 22, 1875.

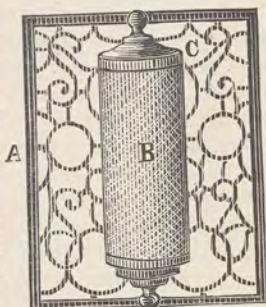


Fig. 1.—A is the register face when in the wall. B represents the ornamental case containing the evaporating vessel as attached to the register. C, the cover, to be removed when filling the vessel with water.

Fig. 2.—D is the form of the porous vessel suspended in the mouth of the



hot-air pipe, directly under the register when in the floor.

*All who value the health and comfort of themselves and families should give careful attention to this Circular and its Testimonials.*



## DR. COLBURN'S POROUS EVAPORATORS.

SIMPLE, EFFICACIOUS, AND RELIABLE.

SUCH an Evaporator has long been sought for by those who have suffered from the injurious effects of the dry, heated air generated by furnaces, stoves, &c., which want has not been met by the various appliances heretofore in use.

This EVAPORATOR being constructed of porous material, permits the water to *percolate through it to the outer surface*, thus bringing it in *direct contact with the heat*, by which it is immediately *evaporated into the room*, producing a *pure, healthy* moisture, and a summer-like atmosphere, which it is impossible to obtain either by generating *steam* from pans connected with the furnace, or by the use of urns or pans on the stove, or in front of the register.

It is well known that hot and dry air from furnaces and stoves absorbs the natural moisture from the pores of the skin, causes headache, hacking coughs, dizziness, and other complaints, which evils are wholly counteracted by the use of the EVAPORATOR.

Among the advantages gained by this mode of evaporation may be enumerated the following:

The *vapor* is produced from *filtered* water; the evaporation is from the vessel's *surface*, and approximates more nearly to that of NATURE than any other artificial method heretofore discovered.

It serves to absorb and to neutralize the noxious gases generated in rooms, whether emanating from the heating apparatus itself, or from plant or animal life.

It is a convenient medium of impregnating the atmosphere of apartments with *perfumes*, or with *medicinal* or *disinfecting* agents, which, if placed in the Evaporator, are in a few seconds disseminated throughout the apartment.

It supplies much needed moisture to house plants, and materially assists in preventing furniture, picture frames, &c., from shrinkage, besides rendering wood-work immediately around the register less liable to take fire or to become charred.

Many persons suppose that sufficient moisture is derived from the evaporation of water in the *cellar*, from *pans* connected with the furnace, but a moment's reflection will convince them that this moisture is *mostly absorbed by the furnace itself*, and by the brick-work which often surrounds it, or is *consumed* in its passage through the hot-air pipes, whereas by placing the EVAPORATOR *at the register*, the *entire* quantity of water is evaporated *into the room*.

Where the register is in the wall, the EVAPORATOR is enclosed in an ornamental case, which is attached to the face of the register, as shown in figure "A."

Where the register is in the floor, the EVAPORATOR is suspended in the mouth of the hot-air pipe, directly under the fans of the register, so that in each case the entire quantity of water is evaporated *into the room*, thus obviating the pernicious effects of the dry, heated air, which has rendered furnaces, stoves, &c., so objectionable heretofore.

The *Scientific American*, in an article showing

the importance of additional moisture in furnace-heated rooms and evil effects resulting from this "dry heat," says: "This trouble has received the most careful attention from scientific men, and it has long been generally admitted that, without proper attention to this important particular, hot-air furnaces are capable of doing GREAT MISCHIEF."

Dr. WM. F. CHANNING, in an article in *Tilton's Journal of Agriculture*, on the "Care of House Plants," showing the importance of moisture in furnace-heated rooms for the preservation of plants, and also of animal life, says:

"The skin and delicate membranes of the throat and lungs parch in the dry furnace heat, just like the leaves of the plants. The freshest complexion becomes wizened by a winter in this sirocco."

The Doctor then asks, What shall be done? and he answers: "Simply introduce EVAPORATORS, which shall furnish to the air at least one-half as much moisture as the air naturally contains at the same temperature in spring or summer. \* \* \* The shrinking of wood-work or warping of furniture are indications of an unnaturally dry heat, which is fatal to plant, and injurious to animal life."

We refer the reader also to an excellent work on "Nurses and Nursing," by Dr. H. R. STORER, of Boston, affording further evidence of the necessity of using the EVAPORATORS in sick-rooms. He says:

"At the Franciscan Home for Sick Women, in Hanson street, I have had EVAPORATORS of this kind attached to every register, with the effect during the cold weather of very materially adding to the comfort and healthfulness of the atmosphere."

The EVAPORATOR was first introduced in this city last winter, although, as shown by some of the

following testimonials, it has been long and favorably known in Boston and vicinity.

In this city it has already been introduced into the houses of many of our most respected citizens, and is daily gaining favor with those who appreciate its merits.

We take great pleasure in inviting the attention of the public to the following

### TESTIMONIALS.

—O—

Report of the Sanitary Committee of the Board of Health,  
Washington, D. C.

Dr. D. W. Bliss, Chairman of the Sanitary Committee, to whom was referred the communication of Dr. G. F. J. Colburn, accompanying "Colburn's Porous Evaporator," reported that the Committee had examined the practical workings of the device as applied to the register of furnaces, Lattobes and the smoke-pipes of radiating stoves, and found that in every instance the apparatus supplied the necessary degree of moisture to secure a pleasant and agreeable atmosphere in the apartments where used. This simple device is constructed of a porous earthen vessel, about four inches in diameter, and ten inches in length. The vessel is placed in a perforated metal jacket or case, and is attached by means of proper fastenings to the face of the register or to the side of a radiating stove or a perpendicular pipe of the same, and is designed to supply a proper degree of moisture to the over-dry atmosphere of apartments supplied by artificial heat. The material of which the vessel is constructed being porous, permits the gradual percolation of the water it contains which rest upon its surface, when the current of dry, heated air takes up its due proportion of moisture and distributes it through the apartments.

The action of the "Evaporator" is measurably automatic, supplying moisture to the heated air in due proportion to the temperature and quantity of air passing over the surface of the vessel. The experiments with this apparatus in the rooms of the Board of Health demonstrate the fact that when the volume of heated air discharged from the register is medium in temperature and quantity, 3 pints of water would percolate through the vessel, be taken up and distributed in eight hours, while the water in the vessel does not attain a temperature exceeding sixty-five degrees Fahrenheit during the process. This quantity of water being distributed in the form of vapor, furnishes 202,500 cubic inches of moisture to the atmosphere, rendering it soft, agreeable, and healthful. It is an acknowledged fact, palpably demonstrated by every day's experience, that the present mode of heating public and private buildings is in direct violation of known principles of properly supplying fresh and the discharge of vitiated



air. In the absence of suitable structures and heating apparatus, this simple device of Dr. Colburn's supplies a most important defect, viz: the want of moisture, and will prevent many of the prevalent dyspeptic and catarrhal maladies incident to the conditions of defective heating and ventilation. It has been in use in the city of Boston and its vicinity for several years, giving entire satisfaction, and has received most favorable mention from the public school authorities, Professor Agassiz and other scientists.

Your Committee would respectfully recommend the use of this apparatus in the schools and other public buildings of the District, and its general use by citizens.

(From HON. E. B. FRENCH, Second Auditor of the Treasury.)

TREASURY DEPARTMENT,  
SECOND AUDITOR'S OFFICE,  
September 28, 1875.

Dr. G. F. J. COLBURN.

DEAR SIR: A trial of your Porous Evaporator during the past year has proved to me that it is all that you claim for it. I would not consent now to occupy a room warmed by a furnace without it, as it supplies the necessary moisture to render the air in the room fresh, soft and pleasant. You will confer a great blessing upon the people, in the shape of comfort and health, if you succeed in securing its adoption, particularly in halls, churches, school-houses and public offices.

Very truly yours, E. B. FRENCH.

(From the Annual Report of DR. CHRIS C. COX, President of the Board of Health.)

WASHINGTON, D. C., September 3, 1875.

It may be added that the use of a proper Evaporator which modifies the extreme dryness of the heated air will render the atmosphere of the house far more tolerable and less injurious. A simple and useful apparatus for this purpose is the evaporating jar of porous earthenware invented by Dr. Colburn of this city, which is readily suspended by a wire connexion to the open register. I can confidently recommend its general use as a convenient mode of rendering less excruciating and oppressive the heat of the ordinary house furnace.

(From HON. C. W. KENDALL, M. C. from Nevada.)  
HOUSE OF REPRESENTATIVES,  
Washington, D. C., 1875.

For the past two winters I have used Dr. Colburn's Porous Evaporator for hot-air registers in my house, and find that the air that was before dry and unpleasant, is, by its use, rendered moist and agreeable.

I can heartily recommend it, and believe those who give it a trial will find that it fulfills all the claims of its inventor, and that its use will prove conducive to health.

C. W. KENDALL.

(From J. G. PAYNE, Esq., Attorney at Law, No. 486 La. Ave.)

WASHINGTON, D. C., September 18, 1875.

Dr. COLBURN.

While confined to the house by illness last spring, I made

a trial of your patent Porous Evaporator, having it attached to the register in my sitting-room. The evaporation into the room supplied to the atmosphere a moisture which was at once perceptible, and of material benefit to health, and which cannot be obtained by the placing of water upon the furnace, or in any place other than the room in which the moisture is desired. Only those who have tried your Evaporator can appreciate its efficiency in the preservation of health and protection of property.

Very truly yours, JAS. G. PAYNE.

(From J. M. SIMS, Esq., No. 1001 N street.)

TREASURY DEPARTMENT,  
SECOND AUDITOR'S OFFICE,  
WASHINGTON, September 18, 1875.

I was induced, late in the winter season of 1874-'5, to use one of Dr. Colburn's Porous Evaporators in my residence. I can safely say it has met my most sanguine expectations for the short time it has been in use. I have found the atmosphere of the room moist and agreeable, and I have no doubt whatever that those complaining of throat disease would experience much benefit from their use. My short trial of the "Evaporator" has convinced me that every household should have one or more.

JOHN M. SIMS,  
Chief of Medical and Orphanage Division.

(From PROF. AGASSIZ, of the Museum of Comparative Zoology.)

CAMBRIDGE, MASS., October, 1864.

I have introduced Colburn's Evaporators in the Museum of Comparative Zoology at Cambridge. I am entirely satisfied with the result.

L. AGASSIZ.

(From WM. W. MORLAND, M. D.)

13 ARLINGTON ST., BOSTON, April 21, 1864.

I have had three of Colburn's Patent Evaporators in constant use for three years, during the winter months, in my house, and have every reason to be entirely satisfied with them. The difference in the atmosphere of the rooms was very marked when compared to what it was before their introduction into the registers. There is no doubt in my mind of their efficiency in softening the dry, heated air from the furnace—an effect I have never found from using water in the iron basin or trough attached to the furnace.

I heartily recommend this simple and successful appliance to all who desire comfort in the use of hot-air furnaces, and am persuaded that as a preserver of furniture it will be found most serviceable.

WM. W. MORLAND, M. D.

(From R. C. GREENLEAF, Esq., Boston.)

I have used Dr. Colburn's Evaporator in my house for two winters, and with pleasure give this testimonial of its excellence.

I am convinced that for health, and for preservation of furniture and wood-work in the house, it is the best thing in use.

(From the Master of the Bowditch School.)

BOWDITCH SCHOOL, BOSTON, Feb. 25, 1864.

Colburn's Evaporator has been used for the past two years in this School. Each room is furnished with one, and there are sixteen of them in use in the building. We have never, therefore, had occasion to breathe that dry, vitiated furnace air which has formed the principal objection to furnaces. The heat in our school-rooms has been peculiarly pleasant and agreeable.

WM. T. ADAMS, Master.

(From L. S. CRAGIN, Esq.)

I have had in my house for over ten years the Patent Porous Evaporator, and should be unwilling to part with it for any consideration.

L. S. CRAGIN, 19 High Street.  
House 44 Worcester St., Boston.

(From WM. POPE, Esq.)

I have used Dr. Colburn's Patent Porous Evaporators for more than ten years, and believe them to be the best Evaporators in use when the building is heated by a furnace.

WM. POPE, 35 India Street, Boston.

(From G. A. MEYER, Esq., Boston.)

Have used Colburn's Evaporator for ten years, and have found great benefit from them. They moisten and soften the air, the effect of which I never experienced from the use of the pan in the furnace.

GEO. A. MEYER, 194 Beacon St., Oct. 24, 1872.

(From J. ANSON GUILD, Esq.)

HOUSE HEATED BY STEAM.

Persons heating their houses by steam will find a great benefit by using Dr. Colburn's Patent Evaporators. Having used them for several years on my radiators, I am glad to testify of their benefits, producing a soft and moist air throughout the house.

BROOKLINE, Dec. 16, 1872

J. ANSON GUILD.

This invention has also been introduced into the residences of several of the most distinguished members of the Diplomatic Corps, among whom we may mention the British, Russian, and Italian Ministers, and the Swiss Consul-General, etc., etc.

Send \$5 and your address, and a handsome one will be sent as a sample by express, immediately upon their receipt. Special quotations made when requested.

For further information, call on or address

GRANVILLE MALCOM,

610 Chesnut Street, Phila., Pa.

At the Clothing House of Mark T. Willis.

No Dwelling House, Public Building,

CHURCH, SCHOOL,  
HOSPITAL, BANK,

Or other Building heated by furnaces, stoves or steam pipes,  
should be without

DR. COLBURN'S  
POROUS EVAPORATOR

FOR

Supplying Moisture to Heated Rooms.

Patented January 22, 1861;  
Reissued April 2, 1861;  
(To cover all porous materials.)  
Extended January 22, 1875.

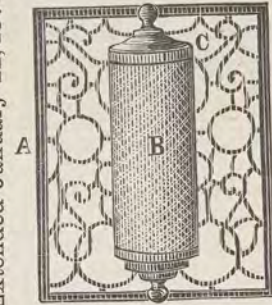


Fig. 1.—A is the register face when in the wall. B represents the ornamental case containing the evaporating vessel as attached to the register. C, the cover, to be removed when filling the vessel with water.

Fig. 2.—D is the form of the porous vessel suspended in the mouth of the



hot-air pipe, directly under the register when in the floor.

All who value the health and comfort of themselves and families should give careful attention to this Circular and its Testimonials.



It seems at first somewhat anomalous in the table given by Dr. Levis, that Jacksonville, Florida, which some persons pronounce damp, has the lowest relative humidity for the five cold months, by observations of five years, standing at 68.8. Punta Rassa, on the Gulf coast, marks 72.7; very near this comes to the better known Mentone and Cannes, on the Mediterranean, which are 72.4. Key West, Florida, is 76.8; Atlantic City, N. J., is given at 78.1; while of two places in Minnesota, Breckinridge stands at 76.8 (!), while St. Paul makes a showing of 71.3.

#### TWO KINDS OF "MOISTURE."

The moisture of the Gulf coast of Florida, however, must be a different type of humidity from the moisture of Breckinridge, Minnesota, or, rather, it is not humidity at all, from the ground. It is aquidity, aqueity, from the warm water surface over which blow the winds of the Gulf. This difference between earth dampness and water dampness, the fogs that roll in from the sea or the exhaling fogs from low-lying lands, is a notable one, and must mark off the humidity tables again into two sections. Explorations in this direction will be interesting.

beneath brows that over three score of winters have made as frosty as his hair.

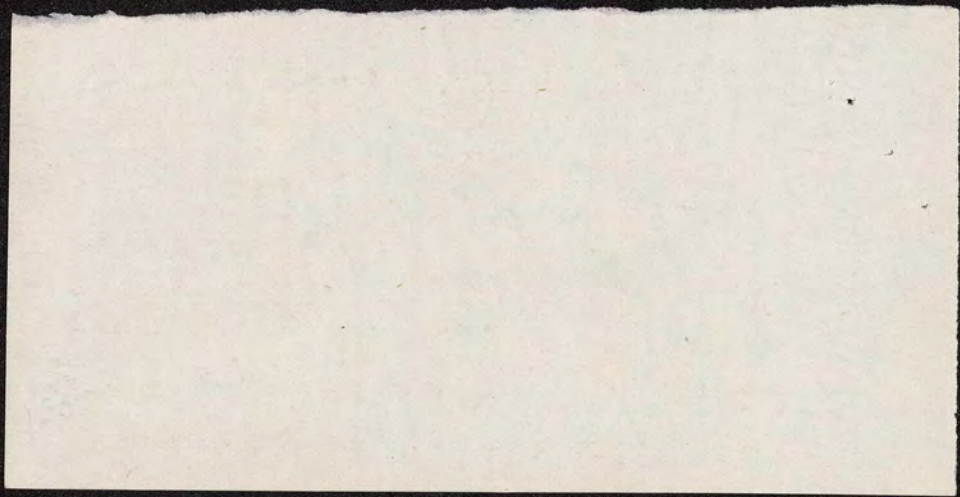
THE TWO-STORIED STAGE of the Madison Square Theatre in New York was anticipated long ago in Japan, where a drop curtain conceals the back of the stage. The stage itself, a circle, is moved upon the principle of a railroad turntable. One half of it is presented with the acting scene upon it, while the other half behind the back curtain is being prepared for the next scene.

PRIVATE ADVICES from London state that the Prince of Wales has instructed a well-known firm of musical instrument makers in New Bond street to supply instruments of the first quality to the eighty performers who formed the orchestra of the Alhambra Theatre, London, and whose instruments were destroyed in the conflagration of the theatre, charging the cost to the Prince of Wales.

NEAR BERLIN, at a place called Pausin, a peasant named Krote owns a small farm on which considerable treasure has been found. Last year he dug up a rather large sum of money, and very recently, while constructing a trench, he found an iron pot containing



[copy]  
Dr Daubeny (1866, London Chem.  
Society) from his exper. at Torquay  
concludes that the presence of the sea favors  
the formation of ozone. He believes how-  
-ever its principal source to be the  
emanation (of oxygen) from plant leaves.  
~~(Ozone)~~





disinfecting power of artificially prepared ozone were quickly undertaken, some of them, as those made by Scouttetten in France ten or twelve years since, of quite an elaborate character. It was then shown that air in which putrid meat had been suspended could be at once deodorized by a small quantity of ozonized air. So, too, ozone was proved capable of purifying the air of hospitals and that of apartments which had purposely been rendered particularly offensive by scattering in the rooms fermenting manure and sewer water.

The subject has latterly again been attracting a considerable degree of attention among physicians, particularly in England and in this country, and at the present moment ozone bids fair to become one of the most popular among the disinfectants, in spite of the danger from fire which attaches to some of the processes by which it is usually obtained, and notwithstanding other inconveniences which still attend its preparation by any of the methods in use.

Of all the methods of obtaining and employing ozone as a disinfectant, the old process by phosphorus appears to be still the one most frequently resorted to. Dr. Moffatt, of England, recommends the following modification of the usual process as being well suited for purifying the sick-room. Rather more than half a pint of water having been placed in a wide-mouthed quart bottle, a piece of wet cork, carrying a flat piece of phosphorus with a cleanly cut surface, is placed upon the surface of the water and left to float there. The mouth of the bottle is loosely covered, but not stopped, with a large cork or bit of wood. The bottle with its contents is then placed first in one part and then in another of the apartment to be purified, until the peculiar odor of ozone is perceptible or until its presence has been clearly indicated by test papers. The purifying process may be performed night and morning, or oftener, as may seem desirable. In order that ozone shall be formed freely by this method the temperature of the apartment in which the apparatus is placed should not be lower than 50° or 60° Fah. The exceeding inflammability of phosphorus, and the danger of having it about, even where none but judicious and experienced persons handle it, must however always be borne in mind as one very serious objection to this substance as a means of disinfection. Another easy method of forming ozone is by means of ether vapor. A few drachms of ether are poured into a large bottle, which is then shaken so that the air within it shall become pervaded with the vapor of ether; a glass rod, which has been moderately heated in the flame of a spirit-lamp, being now plunged into the atmosphere of vapor which the bottle is filled, a quantity of ozone will immediately be formed. A correspondent of the "London Lancet," Dr. Day, has recently been experimenting upon ozone obtained in this manner. He finds that a portion of the ozone, which has been prepared in this way, will remain upon or about the bottle for a number of days, and that after the bottle has once been thus charged, as it were, it may be employed as a very convenient means of disinfection. In the instance which first attracted his attention to this persistence of the ozone, he was surprised by finding ten days after the expiration of an experiment with ozone that the bottle which had been employed was still highly ozonized, although it had been left open and freely exposed to the air. To study more closely this phenomenon, a large glass vessel was ozonized by the same process, and after a few minutes the interior of it was thoroughly rubbed with a towel. It was found that although the towel had become charged with ozone, the glass vessel still retained the power of decolorizing a solution of indigo in sulphuric acid, and of decomposing iodide of potassium, sulphuretted hydrogen, or, in other words, of exhibiting the reactions of ozone. These properties were retained by the glass and the towel for several days, and similar results were always obtained when the experiment was repeated. It was even found that ozone can be obtained by means of some samples of ether without the intervention of heat, it being merely necessary to pour a small quantity of this active ether upon cloths, which thereupon become charged with ozone. Dr. Day states his inability to determine as yet the peculiarity of these active samples of ether upon which their efficacy depends. He inclines, however, to the opinion that these samples have been long kept under conditions favorable to the absorption of oxygen, and that the process of ozonification has probably been stimulated by exposure of the ether to light. This ozone-bearing ether is, however, not readily obtainable. Out of more than thirty samples of ether which were examined by Dr. Day, only one was found which answered the purpose thoroughly, and this was known to be upwards of eight years old. Of the other samples, three or four answered tolerably well, while many gave absolutely no reaction for ozone. It had already been noticed by Schoenbein that a small quantity of pure ether left exposed to diffused daylight during four months, in a bottle which was occasionally shaken, became charged with ozone.

It is a well-known fact that oil of turpentine, a substance analogous to

### OZONE.

SOMETHING less than thirty years ago a Swiss chemist, named Schoenbein, discovered the curious fact that when a bit of phosphorus is exposed to the air, or to oxygen gas, a portion of the oxygen will be transmuted into a new and peculiarly energetic condition. In view of the pungent odor of this modified or active oxygen it was called ozone by its discoverer, from the Greek  $\omega\zeta\omega$ , smell. This ozone exhibits a remarkable power of oxidizing, and so destroying, many chemical substances. Most of the vegetable coloring matters, for example, are quickly bleached upon being exposed to it; and a vast number of foul and unwholesome gases and vapors may readily be put out of existence by virtue of its oxidizing power.

Soon after the discovery of ozone, it was noticed that there is usually a small proportion of it in the atmosphere. This fact at once excited much attention and has led to much research. It is now known that the ozone, as a general rule, is particularly abundant in the open country and at sea, while in the air of large cities there is comparatively little of it at any time. It fails altogether in the air of filthy or pestilential localities, and in that of places where many persons are crowded together, as in the habitations of the poorer classes, in churches, theatres, and hospitals. Ozone can rarely be detected in the neighborhood of cesspools, or of the openings of sewers. Sometimes no trace of it can be found to the leeward of a stable or manure heap, or of a city even, at the very moment when there is an abundance of it to windward.

This deficiency of ozone in the air of crowded localities, or in that which has been in any way polluted, was at once explained by the reducing action of organic matter. It was admitted that volatile organic substances—and of these many stench are known to be composed—upon escaping into the air must quickly be oxidized by the ozone which is normally contained in it. From this the inference was drawn not only that the atmosphere contains within itself the means of its own purification, but also that the purifying agent most immediately concerned is ozone. Experiments upon the

[Don't copy] *ozone and its uses*

[Don't copy] *ozone out in nature*



These are not new truths, but it is new to hear them from the stump in Texas, where hitherto "the ready rope and the convenient limb" have been the simple machinery by which all opinions were reduced to one pattern, and that a very different one from this; and it is strange, indeed, to know that there is actually in the field, prepared for a political campaign, with a full ticket of candidates, an organized party which contends in Texas for what might be called the true Northern principles, if it were not better to call them the true Southern policy. And before it attains power, only too long before it can attain power, it will have purged itself from the only one of its distinctive marks which its friends in the North would gladly see obliterated—the bitterness of its natural hatred against its adversary.

### ROADS.

ABOUT this period of the year there is, all over the Union, or at least all over the Northern States, a general repairing of the roads. The frost is fairly gone. The scars the snow and the winter torrents have left on the highways have to be removed. The season for riding has fairly set in, and ways have to be made safe and pleasant for the great swarm of buggies, wagons, rockaways, barouches, gigs, and chaises, which issue from their winter hiding-places as soon as the spring mud has dried. The roadmasters, contractors, and selectmen accordingly go to work with great zeal and assiduity to put the public highways in order, and the way in which they attempt to do this is so extraordinary that nothing but long habit prevents the public from enjoying its absurdity. There is, perhaps, no way in which we can bring the nature of their process so fully home to the mind of our reader as by stating that, except in very rocky or mountainous districts, there is, perhaps, hardly a mile of road north of Mason and Dixon's line which, after receiving the last touches from the road-mender, is not capable, if the traffic on it be suspended, of producing a luxuriant crop of potatoes, cabbages, or of any other garden vegetable. The reason of this is, that the highway is the only portion of our Northern country which is every year systematically and richly manured. Most city readers, even, are probably aware that, roads being generally slightly elevated, there runs along on each side of them a hollow or ditch into which the rains sweep most of the mud from their surface as well as the mould of the adjoining fields, the dead leaves of the trees, and a large quantity of other decaying or decayed vegetable matter. These, consequently, form on the road side deposits of soil or manure of great value for agricultural purposes, and which farmers, if they were wise, would cart away and spread over their weary fields. It accumulates, however, without disturbance during the summer, fall, and winter, and in the spring comes the road-mender and scrapes it out, sometimes with a spade, sometimes with a plow and yoke of oxen, and carefully spreads it on the middle of the highway wherever he sees a hollow place. Most intelligent foreigners who witness this process, and are not familiar with the agricultural theory of roads, are apt to imagine that it is dictated by malice or carelessness—that the farmer wants to clean his ditches out, and, to save himself trouble, dumps the contents in the road, in sheer indifference to the comforts or convenience of travellers. And nobody who was familiar with the result could honestly say that this suspicion was entirely unjustifiable, for the stuff that is thus put on never hardens. After rain it becomes a quagmire; two or three days of sun convert it into dust, which horses and wheels raise into thick clouds, rendering driving in dry weather something only to be undertaken under pressure of necessity. It is not unnatural, therefore, to ascribe the putting of it in to malignity or selfishness. Nature, if left to herself, converts a track made over most parts of the country into a tolerably good road in time. The rains wash away the loose and soft clay from the surface and bring us rapidly down to "the hard pan," which, if kept tolerably level by filling the hollows with gravel and picking out protruding stones, is perhaps as good a highway as we can have without paving or macadamizing, except in very miry districts where the subsoil itself is soft. But this our road-menders are careful not to do. They pile on the "hard pan" all the soft, glutinous, gelatinous substances to be found in the neighborhood, or, in other words, supply the materials for the two great pests of American country life—the mud and the dust. On the by-roads this nuisance is not so serious, because they are very rarely repaired, and one can accordingly often jog over them, if with a good deal of jolting, at least with eyes unbleared and lungs and nostrils unchoked. But the post-roads and great thoroughfares no trouble is spared to make impassable. Whatever ploughing and piling up soft dirt can do to make them killing to beasts and offensive to men is done with almost amusing conscientiousness. We never pass a party repairing a road in this way that

was shown a few years ago by the number of plank roads constructed; but it is safe to say that but very few people who have not seen the network of roads by which continental Europe and England are covered, or those of the Central Park, in New York, have any adequate idea either of what a good road is, or what a luxury it is to those who live along it or have occasion to use it. The notions of the farmers about what constitutes a good road are revealed in the kind of thing which they dress up in spring, and call a good road—a bank of soft earth, slightly convex, and as far as contour goes sufficiently near perfection, but allowing wheels in wet weather to sink axle-deep in mud and in dry weather axle-deep in dust—in other words, differing in no respect from the adjoining fields except in the absence of grass and in being smoothed off.

This horrible simplicity of ours in the matter of roads, and, in fact, in all matters connected with travelling, is rendered more remarkable by our luxuriousness in other things—hotels, for instance—and by the fact that there is no people in the world who ride in carriages so much for pleasure. We believe there are not less than twenty carriages kept in America in proportion to population, for mere recreation, for the one kept in any European country, and, if we put aside the hacks in the great cities, in the use of which Europeans, for obvious reasons, far surpass us, we believe it is safe to say that for one vehicle hired in any European country for recreation, forty are hired here; so that there is, perhaps, no country in the world in which the condition of the roads is of so much importance to so large a number of persons. Why, then, are they not better?

That their length is so great in proportion to the population, may be a sufficient answer as far as regards the West, but not as regards the Eastern States. The roads round Boston, or New York, or Philadelphia are in precisely the same condition as those of Iowa or Minnesota; that is to say, they are hard or soft, wet or dry, according to the nature of the soil over which they pass, although they lie in some of the most densely peopled districts of the western world. Nor is the great cost of macadamizing any answer either. There are no richer communities to be found anywhere than those of our Eastern States—as compared say with Ireland or Switzerland, they may be called



of this knife, M. Broca could really see nothing alarming in the powers of the knife; but that may be from his temperament being different to that of M. Demarquay.—*Ibid.*

*Alcoholized Milk for Infants.*—M. JULES SIMON, in his new work *Le Travail*, states that at Jelle and Rouen there are some women so saturated with intoxicating liquor that their infants refuse the breast of a sober woman. In the mountains of the Vosges the infants drink brandy.—*Lancet*, April 7, 1866.

*Poisonous Principle of Mushrooms.*—Dr. Letelleir says, that the poisonous substance in mushrooms is a fixed, non-crystallizable, narcotic principle—amanitine. It is precipitated by iodine and tannin. The treatment for poisoning thence resulting is vomiting and purging, followed by a strong aqueous solution of tannin.—*Brit. Med. Journ.*, April 7, 1866.

*Deodorizing Properties of Ground Coffee.*—Dr. BARBIER affirms that ground coffee possesses some remarkable properties as a disinfectant. In several cases where he had to make post-mortem examinations of bodies under very disagreeable circumstances, he found that a handful of coffee strewn over the body and about the room quite overcame any bad odour.—*Lancet*, April 21, 1866.

*Ozone.*—For the past few months our continental neighbours have been making known some valuable additions to the knowledge of this body, to the more interesting of which we shall call attention.

Our readers are probably all aware that the existence of a substance, called by its discoverer *ozone*, was made known to the scientific world by Schœnbein. He did not then isolate it as hydrogen, iodine, magnesium, or other substances have been isolated; nor has he or the other workers at the subject succeeded in doing so since, although more than the quarter of a century has elapsed since its nature first became matter for investigation.

To form it there must, all are agreed, be *oxygen*, but we can hardly say that all are also agreed that there must not likewise be hydrogen, or rather, perhaps, water. On the whole, however, the experiments of

Andrews and Tait may be considered as settling the question at rest, at least, so far as this: From oxygen alone some of the phenomena indicating the presence of ozone can be obtained. The question is not so satisfactorily answered as to whether the substance that is formed in presence of water-vapour, and answering to the tests of ozone, is formed from oxygen only, or from a combination of oxygen and water.

But we must not say more of its nature until we have stated some of the means of obtaining it, or, more correctly speaking, obtaining indications of its existence. If perfectly dry and pure oxygen gas be electrified by passing a series of sparks through it, or, even better, according to Dr. Andrews, by silently discharging machine-electricity through it, ozone is produced. That is to say, the oxygen acquires new properties. It acquires a peculiar smell, such as is observed on standing near a large electrical machine in action, or much like that of a dense fog. It diminishes in volume. It becomes capable of *oxidizing* bodies in a way that it could not do before, so that it becomes corrosive, destroying most organic substances, such even as caoutchouc, and acting on metals, even silver, oxidizes and decomposes salts ordinarily stable, such as sulphate of magnesia and iodide of potassium, and even combines with the inactive substance nitrogen (in the presence of moisture). It is practically insoluble in water, but is absorbed by it if the water contains a material quantity of organic matter. If the oxygen which has been thus changed is treated with some of the substances affected by it, these active properties disappear, and a great part of the original oxygen employed is left unchanged. But Frémy and E. Becquerel have shown that by electrifying the oxygen in contact with moist metallic silver, or a solution of iodide of potassium, all the oxygen can be so changed as to be absorbed by these substances.

Other methods of forming ozone in the presence of water are by gently heating a mixture of air and ether vapour, or by exposing clean moist phosphorus to the air. In these cases the formation of the ozone seems to be simultaneous with the partial oxidation of the acting substance. It is also formed during the electrolysis of dilute sulphuric acid, or, as it is the fashion to say, of water acidulated with sulphuric acid. And also by the action of sulphuric acid

Don't Copy



on peroxide of barium, and by other laboratory methods.

It has been shown to be formed during fermentation and the growth of moulds, and it is believed to be very generally produced during oxidation at ordinary temperatures. It, however, can hardly be said for certain that oxidation is a cause of the ozonization of oxygen, as we know that all the oxidations that do take place are producible by ozone itself, so that it may be that ozone is produced by the contact of oxygen with these bodies, or in other ways, and that then these bodies begin to oxidize under the action of the ozone.

Now, with regard to the test of its presence, there are several, but there is hardly one of them which cannot be challenged as an uncertain indication of it. One of the earliest tests employed, but seldom used now, was a white paper impregnated with sulphate of manganese, an almost colourless salt. This paper is turned brown by the formation of hydrated peroxide of manganese. Another test, proposed by Schœnbein, and the one most in use at present, is white paper impregnated with starch-paste and iodide of potassium. This paper is turned blue, or a colour approaching it, by ozone, potassa being produced and iodine liberated, which then forms the blue compound of starch and iodine. M. Houzeau has introduced, and for a long time employed, strips of wine-coloured litmus-paper, half of each of which only is impregnated with iodide of potassium. This he does because there are other substances that are liable to change the iodized starch-papers by liberating iodine which will not affect these papers. For these other substances liberate the iodine by forming a neutral salt with the potassium, such as acid vapours, chlorine, etc., but ozone does so by forming potassa, which is alkaline. This alkalinity his papers indicate by the part charged with the iodine becoming, under the influence of ozone, blue from the action of the potassa on the violet litmus, and then contrasting with the unchanged colour.

We have already indicated the most striking properties of ozone, but there are still some things requiring notice. By its powerful oxidizing action on organic matter, it quickly purifies air or water charged with organic matters, removing smell and taste from them. Indeed, the most offensive masses of putrid matter lose their offensive-

ness to the senses by the action of this body. Its active chemical properties render it a powerful irritant to mucous surfaces. By heat ozonized oxygen loses all the properties of ozone, and regains its own; among others, its proper volume.

We have also to say a little concerning the destiny of ozone. Since oxygen converted, or partly converted, into ozone, contracts in volume, it is evident that ozonized oxygen must be denser than ordinary oxygen. Attempts have recently been made to determine its destiny, by M. Soret. We must mention that when ozonized oxygen is exposed to the action of iodide of potassium or moist silver, it loses its peculiar properties, except that it does not reassume its original volume, as it does when heated. Further, that the loss of oxygen is accounted for, and the absorption of ozone proved, by the fact that a quantity of iodine chemically equivalent to this oxygen or ozone is set free from the iodide of potassium. It is just possible, it seems to us, that ozone may be a vapour of very low tension, of a highly volatile liquid, which we have not yet been able to get in sufficient quantity in a given space to make it reach the point of maximum density, when formation of liquid would take place. For, then, the slight loss of elastic force by the absorption of it from its mixture with oxygen might well escape observation. However, chemists do not seem to hold this view. The one which has for some years been suggested is that ozone is half as dense again as oxygen. On this hypothesis, iodide of potassium is considered to absorb one-third of the matter of ozone, and to liberate the other two-thirds as ordinary oxygen. This, of course, requires the further admission that the ozone behaves as if formed of two kinds of matter, two kinds of oxygen, and that it is an oxide of oxygen having the formula  $O_2O$ . We shall not pretend to criticize this hypothesis. We refer to it here, partly because M. Soret has attempted to determine the density of ozone, and he finds his experiments confirm the view that three volumes of oxygen are condensed to two. He has discovered that oil of turpentine so acts upon ozonized oxygen as to cause the volume of the gas to diminish, instead of this remaining unchanged, as when iodide of potassium acts upon it. He concludes from this that iodide of potassium decomposes this compound oxygen, or ozone, and



for Board

Extension of Enthetic (Epidemic, endemic, infectious or contagious) Diseases,  
through the Atmosphere &c.

- ① Chemical Theory, of <sup>Eremacausis &</sup> Typhoid: — Liebig.  
③ Theory, of Disease-Germs: — Pasteur, Hallier, &c.  
② Continuous Molecular Change: Theory of Snow.  
④ Transplantation of Bioplasts: Theory of Bpale.  
Present state of the Investigation:

Do the "aerozoa" cause,  
& "aerophyta"  
or only Concide with,  
the occurrence of  
putrefaction and  
septic disease?  
[Eggs of my  
Puccinia? wheat, &c.]

It is probable that most aerial organisms consume septic  
matter, so as to purify the air; but that some <sup>of them may</sup> induce fermentation, putrefaction,  
and septic changes in living beings; <sup>and others are effective carriers of morbid materials;</sup> <sup>producing disease</sup> especially when those beings are already  
debilitated, — and when the minute atmospheric organisms are multiplied  
out of proportion to the material on which they live.



Egypt 7. me

Puccinia of Wheat (Mildew?)

Edward



that the experiments of Dr. Sanderson have established the fact that in an infusion of turnips and cheese prepared as directed by Dr. Bastian, heating to a temperature of 102 C. is sufficient to prevent the subsequent development of life (Bacteria) in the infusion even when the exposure to that temperature is only maintained for a few minutes. Boiling for five or ten minutes, according to Dr. Sanderson, is not sufficient to prevent the subsequent development of Bacteria, but according to the experiments of Dr. Pöde and myself, boiling for ten minutes or a quarter of an hour *is* sufficient, provided that care has been taken to exclude visible lumps of cheese, and when the infusion is enclosed in a tube which tube is submerged in boiling water. Further, Dr. Sanderson has stated the following most important result, namely, that exposure to the boiling temperature (100° C.) was in all cases sufficient to prevent the subsequent development of Bacteria if it was carried on for so long as *one hour*.

no wish to appropriate from his Grace, and desirous of giving him due credit for what he had done, will, I hope, be evident from the following quotation :—"In order to utilise the air as a means of transit, the body in motion, whether it moves in virtue of the life it possesses or because of a force superadded, must be heavier than it. If it were otherwise, if it were rescued from the operation of gravity on the one hand, and bereft of independent movement on the other, it must float about uncontrolled and uncontrollable, as happens in the ordinary gas balloon. The difference here insisted upon was, I have learned since writing the above, likewise pointed out by his Grace the Duke of Argyll, in his very able and eloquent article in *Good Words*, entitled the 'Reign of Law.' . . . This article, I am glad to find, has been reprinted in a separate form with numerous illustrations, and should be read by all interested in the subject of aëronautics." ("On the various Modes of Flight in Relation to Aëronautics;" Proceedings Royal Institution of Great Britain,



Using tubes of quarter-inch bore and three inches in length half filled with Dr. Bastian's infusion, and then submerged in water maintained at the desired temperature, I found that exposure for *six hours to a temperature of 75° C. was sufficient* to prevent the subsequent development of Bacteria. The same infusion enclosed in a similar tube and not heated at all, teemed with living Bacteria after four days; the same infusion boiled for ten minutes in an open tube remained barren. I submit this plan for a series of experiments to the readers of NATURE, without attaching much importance to the single but definite result which is above recorded.

kite, the only difference being that the kite is *pulled forward* upon the wind by the string and the hand, whereas in the bird the wing is *pushed forwards* on the wind by the weight of the body and the life residing in the pinion itself." (*Op. cit.*, March 22, 1867.) The Duke, it is true, compares the expanded motionless wings of a bird when sailing to a kite, while I, as stated, attribute a kite-action to the wings both when they rise and fall. The kite-action in the one instance is, however, not to be confounded with the kite-action in the other. That the wings invariably strike *downwards and forwards* during the down stroke, and *upwards and forwards* during the up stroke,



I have not seen any reference in the pages of NATURE to the experiments which have been carried on in German laboratories in consequence of Prof. Huizinga's advocacy of Abiogenesis. Dr. Paul Samuelson, experimenting with Huizinga's infusions under the direction of Prof. Pflüger of Bonn, has obtained results which negative the inferences of Prof. Huizinga. Dr. Samuelson's paper appeared in Pflüger's *Archiv*, during the past year, and another experimenter (to whom I am unable to refer explicitly) has obtained equally definite results opposed to the speculations of Bastian and Huizinga.

Paris, Feb. 8

E. RAY LANKESTER

"hypothesis"—a sense which quite justified him in saying of himself "hypotheses non fingo"—Newton says :—

"In experimental philosophy it is not to be taken in so large a sense as to include the first *Principles or Axiomes which I call the laws of Motion. These Principles are deduced from phenomena and made general by Induction, which is the highest evidence that a Proposition can have in this Philosophy.*" (Letter lxxxi., edited by Edleston.)

And in the next letter he says :—

"On Saturday last I wrote to you representing that Experimental philosophy proceeds only upon Phenomena and deduces general Propositions from them only by Induction. And such



sidered at rest. Opportunities for such observations occur rarely, but it is important that they should be seized whenever they do present themselves, and perhaps no better mode of investigation can be adopted than that followed by Dr. Marckwald.—*Lancet*, Jan. 8, 1876.

*Optical Deportment of the Atmosphere in Reference to the Phenomena of Putrefaction and Infection.*

It was asserted long ago by PASTEUR, and has since been asserted and denied alternately by different experimenters, that in putrescible solutions, such as infusion of turnips, no organic life is developed and no putrefaction takes place as long as the solution, after boiling, is exposed only to an atmosphere free from organic germs, in short, that life is never, in our experience, developed from lifeless matter. Among the opponents to this theory, the foremost has been Dr. CHARLTON BASTIAN, whose experiments convince him that organic life is constantly developed in liquids which have been hermetically sealed in flasks, while boiling. Dr. Bastian goes even further, as the following passage from one of his letters will show: "I have heated flasks, sealed in the ordinary way, and containing the fluid above mentioned [the turnip-cheese infusion], to a temperature of 105° C. for ten minutes in a chloride of calcium bath, and have found these fluids swarming with bacteria after six days."<sup>1</sup>

Professor TYNDALL's researches on this important subject, and the well-devised and well-executed experiments which he exhibited a few days ago to an audience which crowded the theatre of the Royal Institution to the roof, are a continuation of those on the floating particles of the atmosphere, which attracted so much attention some years ago. He has found that these particles can be completely removed from the air by heat, which destroys their organic matter; by filtration through cotton-wool, or, less completely, through the lungs; or by deposition, which last process requires several days for its completion. The most delicate test of freedom of the air from solid matter was found to be the passage through it of a beam of light. The path of the rays from an electric lantern is clearly marked in ordinary air by the illumination of the motes that float in the air; but if a flask of filtered or otherwise purified air is interposed, no such illumination takes place, and the space inside the glass vessel appears dark. For the same reason, a flask filled with clear liquid transmits the light, acting as a rough lens, while the liquid inside remains dark; but a turbid liquid reflects the light at all possible angles, and appears brilliantly luminous in consequence. The beam of light is therefore a test, not only for solids floating in the air, but also for solids floating in liquids; and as turbidity is an invariable consequence of the establishment of putrefaction or fermentation in a liquid, the use of the test is obvious.

So far the experiments, though interesting and suggestive, brought out no new truth. That floating particles existed in the air, that they were partly organic, and that they could be removed more or less completely by filtration through cotton-wool, were facts known before; and the correlation of these facts with the current theories of putrefaction, fermentation, and zymotic disease was obvious. The agency of the air in these processes was doubted by few; and the idea that the solid particles of the air were the active agents in them was entertained by many. It remained to connect by direct evidence the solid particles and the zymotic changes, and to prove that when the solid particles were excluded the zymotic changes did not occur. As far as putrefaction is concerned, this direct evidence has been supplied by the experiments we are about to describe.

An air-tight wooden box was made, of which one side was glass, while each end had a glass window through which the beam of light could pass. Through the bottom passed several test-tubes, sealed in their holes, and with their open ends upwards. In the top was an India-rubber stuffing-box, through which passed a long pipette by which liquid could be dropped into each test-tube in

<sup>1</sup> *Nature*, April 23, 1874.

Jeffrey Thomson,  
5 hours

Tyndall's last observation  
1876



turn. The inside of the box was moistened with glycerine, so that all particles that settled on it might be retained. Alterations of volume were provided for by small tubes, plugged with cotton-wool at the top. So prepared, the apparatus was allowed to remain at rest for three days, until by the passage of a beam of light through the windows the freedom of the inclosed air from dust was proved. Then organic solutions of various kinds, infusions of turnip, and of many kinds of fish, flesh, and fowls were dropped into the tubes. If our memory serves us rightly, about one hundred and thirty different infusions were used in turn. The liquids in the tubes were then boiled from below for five minutes, and the apparatus placed in a room maintained at a suitable temperature. Similar experiments were made in atmospheres purified by filtration and by calcination; but in all the results obtained were identical. *Except in a few cases where the cause of the failure was certain and obvious, no turbidity occurred, and no organic life was developed in one single sample, even after the lapse of weeks or months.* Every one of the same solutions, when exposed to ordinary air, putrefied rapidly.

It is difficult to see any flaw in the evidence here represented. The conditions were apparently far less stringent than in Dr. Charlton Bastian's experiments, and the aptness of the solutions for putrefaction was proved in each case. The only obstacles to the spontaneous generation of bacteria were the five minutes' boiling and the purification of the air; and yet these obstacles were in every case sufficient. It seems, however, that the advocates of heterogenesis are by no means content to accept these results as final and conclusive. The last word in regard to this matter has yet to be spoken, and we are informed that Dr. Bastian is prepared with some fresh experimental evidence which he hopes soon to bring before the Royal Society in support of the position for the truth of which he has so strenuously contended.

Some highly interesting experiments on the lateral and vertical spread of the infection (for so Professor Tyndall metaphorically called it) of putrefaction were also shown at the lecture. Frames, each containing one hundred tubes filled with organic solutions, were piled on one another, and the progress of putrefaction in each tube marked from day to day and recorded on charts. The general result seems to be that the action spreads most rapidly downwards; but upon this branch of the subject space forbids us from enlarging.

That the floating particles of the atmosphere really carry the solid germs or seeds of the bacterium, penicilium, etc., can scarcely remain a matter of doubt. That they are invisible to the naked eye; that some of them are invisible under the highest powers of the microscope, hardly affects the argument; and the illustration with which the lecture virtually terminated will probably be accepted by all our readers. We do not profess to give the exact words. "Let us imagine that these minute and invisible particles were increased in size till we could see and handle them, that we planted them in garden-mould, and that in a week's time there came up a crop of cress or of grass—would any sane man have a doubt as to their nature?"—*Lancet*, Jan. 29, 1876.

## Materia Medica and Therapeutics.

### *Alcohol in Therapeutics.*

The *Bulletin Générale de Théraputique* for Oct. 15, 1875, gives an abstract of a discussion on this subject which took place at the International Medical Congress at Brussels during the past year.

The subject was opened by a paper read by Dr. DESGUIN, of Antwerp, of which the following are the general conclusions:—

"Two phases should be distinguished in the physiological action of alcohol and alcoholic drinks. The first is characterized by excitation of all parts of the nervous system, ganglionic as well as cerebro-spinal; the second, by the depression of all the acts of organic and animal life. These two modes of action are not contradictory; physiology demonstrates that the second is only the



—Prof. Thiselton Dyer, adverting to some statements about the cultivation of fungi, stated that, according to Thore, cited by Duchartre, *Agaricus Palomet* and *Boletus edulis* are sown in the Landes by watering the soil with water in which these species had been boiled. The spores of various other species will, it is said, endure a temperature of  $212^{\circ}$  F., and those of *Periza repanda*

|                                                                                                  |    |
|--------------------------------------------------------------------------------------------------|----|
| FROM THE <i>Challenger</i> , II. By FLO. WYVILLE THOMSON, F.R.S.<br>( <i>With Illustration</i> ) | 51 |
| A MODERN STERNBERGIA. By Principal J. W. DAWSON, F.R.S.                                          | 53 |
| NOTES                                                                                            | 53 |
| THE BIRTH OF CHEMISTRY, X. By G. F. RODWELL, F.C.S. ( <i>With<br/>Illustrations.</i> )           | 56 |
| SCIENTIFIC SERIALS                                                                               | 57 |
| SOCIETIES AND ACADEMIES                                                                          | 58 |
| DIARY                                                                                            | 60 |



URE May 15, 73.

59

even, according to Schmitz,  $230^{\circ}$  F.—The Rev. M. J. Berkeley said there was no doubt that fungus spores would bear a high temperature. The development of a *Penicillium* in the interior of loaves of the *pain de munition* almost immediately after they were drawn from the oven to the temperature of which the spores must have been fully exposed, was a case in point. S.

May 15. 73

60

NAT

—every grain being like its parent. The corn plant produces two ears on each stalk. As soon as the “silk”—the pistils of this second ear—appeared, the pollen—in a “tassel”—of the common yellow flint corn was procured, set in a bottle of water tied near the developing ear, the plant's own tassel having been cut away



Prof Brewer (Allen Jour May 66) describes  
obs. on hot spring of Calif. — where  
low forms of veg. life center. (uncellular  
plants & filamentous. Confers of bright green  
color) in water from 125° to 160° Fahr. — &  
some about 200° Fahr. Obs. in Nov 1861.  
Others have ~~noted similar things~~ <sup>observed</sup> at hot springs since.

*Lewisia rediviva*, a portulacaceous plant  
large flowered fleshy of Butte County, <sup>Oregon &</sup> Calif. — will grow <sup>after being</sup> dried a herbaceous for  
2 or 3 yrs — <sup>specimens</sup> & are en-  
troublingly sprouting  
between the papers. — a ~~plant~~ <sup>specimen</sup> was  
(by Dr. Syall of Butte valley) immersed in boiling  
water before drying — but a year & a half  
afterwards was alive, & in May 1863 produced  
its beautiful flowers in the Ken Gardens.

See Pouchet "Unimex"  
on vitality of <sup>from</sup> *Rotifera* <sup>below zero</sup> to 176° F. <sup>Anguillula</sup> also. — Oct. 1866



Pasteur versus Pouchet  
in regard to spontaneous generation.

Prof. J. H. Bennett of Edinburgh

1869 (Pop. Science Review) writes  
in favor of "spontaneous generation"

Dr. does R. Owen, in last vol.

of his great work a Comp. Anat.  
Dr. Charlton Bastian, Nature, 1870.  
Huxley contradicts his assertions.

Wynn's last experiments

Calvert & Tyndall

Frankland's later - versus Bastian -  
1870

Are these minute organisms

(organs Liebig)  
of fermentation & putrefaction - or concomitant  
of fermentation & putrefaction, using up results  
Probably the latter. Lister's Carbolic acid  
in surgery

of the expansion of the  
of the expansion of the  
of the expansion of the



THE ACTIVE ELEMENTS IN VIRULENT FLUIDS.—

At a recent meeting of the French Academy, a lively discussion took place between Chauveau and Colin, the former maintaining his well-known views that in infectious fluids, the agents are minute solid particles, the latter insisting that fluids may still be poisonous when they have been deprived of every particle.

1876

lar Colleges during the recent commencement season.

AN ANCIENT ÆSCULAPIAN TEMPLE.—A Monolith has been recently discovered in the rear of the Cathedral Notre Dame, which is said to prove the existence of an ancient temple, dedicated to Æsculapius. According to a writer on antiquities it is supposed that this temple existed on the present site of the Hôtel Dieu.



[Trichina] ←

A FLY OF AFRICA.—There is a Cayenne fly, called the *Lucilia Hominivorax* (man-eater), which commits great havoc among the convicts sent out to that colony by the French government. M. Charles Coquerel says that this fly lays its eggs in the mouth or nostrils of a sleeping convict, especially a drunken one, and that the offspring, in their larval state, usually bring about the death of their victim.—*Southern Medical Record*. (1)

67, had had difficulty of swallowing for ten months, and for seven months had been unable to swallow solids. He had lost his voice for four months, although there was no difficulty of breathing. A bougie did not pass beyond the commencement of the œsophagus; and on bending the head forward, so as to relax the front cervical muscles, a hard tumor could be felt on the left of the trachea, behind the sternal end of the clavicle, too low down to promise anything from attempt at œsophagotomy. He had lost very much flesh. Previously stout, his abdomen was now fallen away,



The tubal cysts, on the other hand, contain albumen and a little paralbumen. (Acetic acid increases the precipitate.) Exceptions to these rules exist, but they are very rare.

M. Koeberlé closed his communication with the following table, which includes the principal differential characteristics of these cysts:

*Serous subperitoneal cysts.*—Always unilocular. Contents very fluid, usually colorless and limpid as water, sometimes very saline; contain as a rule no albumen. Albuminous precipitate obtained with nitric acid, may be soluble in an excess of that acid.

*Ovarian cysts.*—Uni- or multilocular. Contents fluid, flowing more or less slowly, viscid, glutinous. Usually rich in albumen, metalbumen, paralbumen, giving with nitric acid a precipitate soluble in acetic acid.

Contents more or less glutinous, sometimes entirely incoagulable by nitric acid and heat; in rare cases limpid as water, slightly frothy, containing only traces of albumen (Colloid cysts).

Pure fat, fluid, mucus, masses of epidermis, hairs in suspension (Dermoid

THE SO-CALLED FUNGUS FOOT OF INDIA.—The cause of this strange disease, which occurs in some parts of India, especially in Madura (whence one of its names), has been attributed by Vandyke Carter to a fungus. Although the evidence was in favor of a fungus being the cause of the Madura foot, yet decided opinions of a contrary kind have not been wanting. Drs. Lewis and Cunningham, after years of study and examination of this disease, entirely negative the view that the disease has a fungoid origin. They have found indeed, in one variety, a fungus; but this appeared to be entirely secondary. They distinguish three varieties of the fungus foot, viz., the roe-like bodies, the pink particles, and the black masses. The first are shown to be fat in variously modified forms; the second are found to be pigmented concretions, not the slightest trace of a fungus or of other vegetable organisms being present in either; and the third are shown to consist of degenerated tissue, mixed to a greater or less extent with black pigment and fungoid elements. They deny that fungi or allied forms can act on healthy tissue, and really assert that disease of tissue always precedes their appearance, and is really the primary disease. They even appear to imply that fungi will only act on matter already dead, and that, therefore, living parts can never be infected by low organisms.—*The Lancet*, January 22, 1876.



Panum (1856)

Robin

Bergmann,  
Liebig

for catalytic

Septic

Also

action

Billroth  
Hiller

~~Bastian~~

BW Richardson

Sandtor,

Lebert,

Nageli

Harley Jacobson

Cyster & Satterthwaite

for infection by

organisms

Kinder, Linnans,

Indle, Fisher

Samuel Mitchell

Erst, Vassiloff,

Hueter, Tommasi,

Ehrt, Klebs,

Talamor, Cohnheim

cone & filter

Billroth  
Hiller  
Bastian

BW Richardson  
Sandtor,  
Lebert,  
Nageli

Harley Jacobson  
Cyster & Satterthwaite

for infection by  
organisms

Kinder, Linnans,  
Indle, Fisher  
Samuel Mitchell  
Erst, Vassiloff,  
Hueter, Tommasi,  
Ehrt, Klebs,  
Talamor, Cohnheim



HEADQUARTERS  
CITIZENS' ASSOCIATION 22d WARD.

---

EVERY CITIZEN SHOULD VOTE!

---

*ELECTION TUESDAY, FEBRUARY 21st, 1882.*

PREPARE YOUR TICKET AT HOME BEFORE GOING TO THE POLLS.

---

## THE REASON WHY.

Having endorsed the nominations of **SAMUEL K. FELTON** and **CHARLES W. HENRY** for **COMMON COUNCIL**, we ask every citizen to support and vote for these candidates for the following reasons:—

**First.**—By the election of **Mr. FELTON**, the large district comprised in Old Bristol Township, which by its position is more or less cut off from intercourse with the rest of the ward, will secure what it greatly needs and what is justly due it,—a representative who appreciates its wants, and will therefore the better serve its interests.

**Second.**—By the election of **Mr. HENRY**, a faithful and efficient Councilman, who, by his past conduct, has shown himself to be in the interest of the people, and alive to the necessities of the ward, will be returned.

**Third.**—By the election of **Messrs. FELTON** and **HENRY**, you will secure in Common Council two representatives whose independence of party ties is a guarantee of their aid in the work of establishing the City Government on a strictly business basis.

**Fourth.**—Neither **Mr. FELTON** nor **Mr. HENRY** will be bound by the dictates of the few unscrupulous men who have so long controlled all the departments of the City Government, running them in their own interests and to their own profit without consideration of the people's good.

**Fifth.**—Because **Mr. Edwards**, one of the present incumbents and a candidate for re-election, is the choice of the **GAS and WATER DEPARTMENTS**, and not of the people.

**Sixth.**—Because **Mr. Edwards'** record in Council shows him to have acted on behalf and in the interest of those who—while they should be the servants—have claimed a mastership over the people.

We would also recommend for your support **Mr. JOHN J. CROUT** and **Mr. JOSEPH J. McCORMICK** as **MANAGERS OF THE POOR.**

## WORK AND VOTE FOR THE CITIZENS' TICKET.



Klebs =

Hyphomycetæ,

Algae,

Schizomycetæ.

H., achorion, trichophyton, oidium

A., leptothrix, sarcina

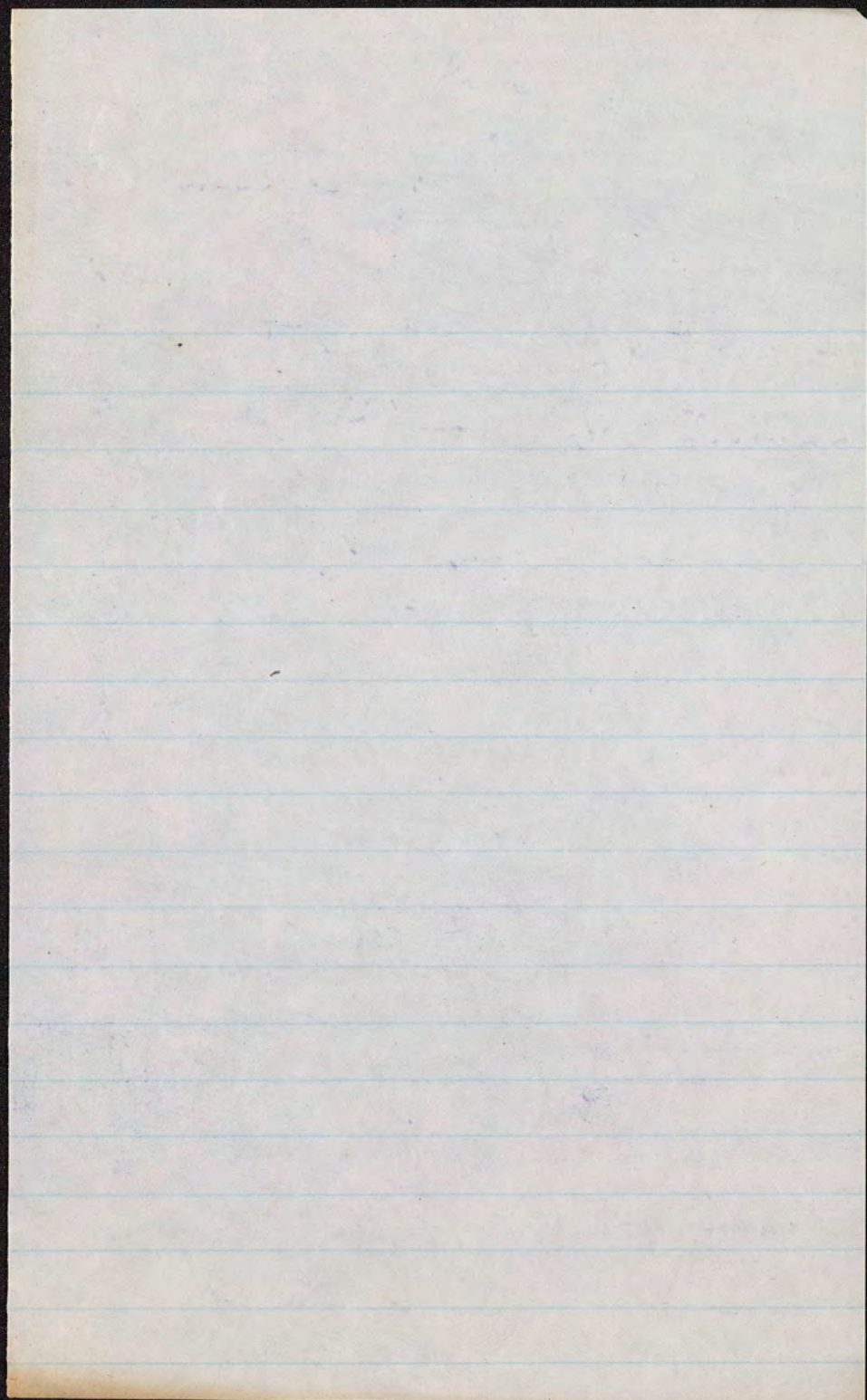
S. (Cohn) micrococcus,  
bacterium,  
bacillus,  
Spirillum

Micrococcus of diphtheria, <sup>ulcerative endoc.</sup> & septicaemia

bacterium (term) of putrefaction

Bacillus of anthrax, of typhoid, of lepra,  
of malarial fever

Spirillum of relapsing fever

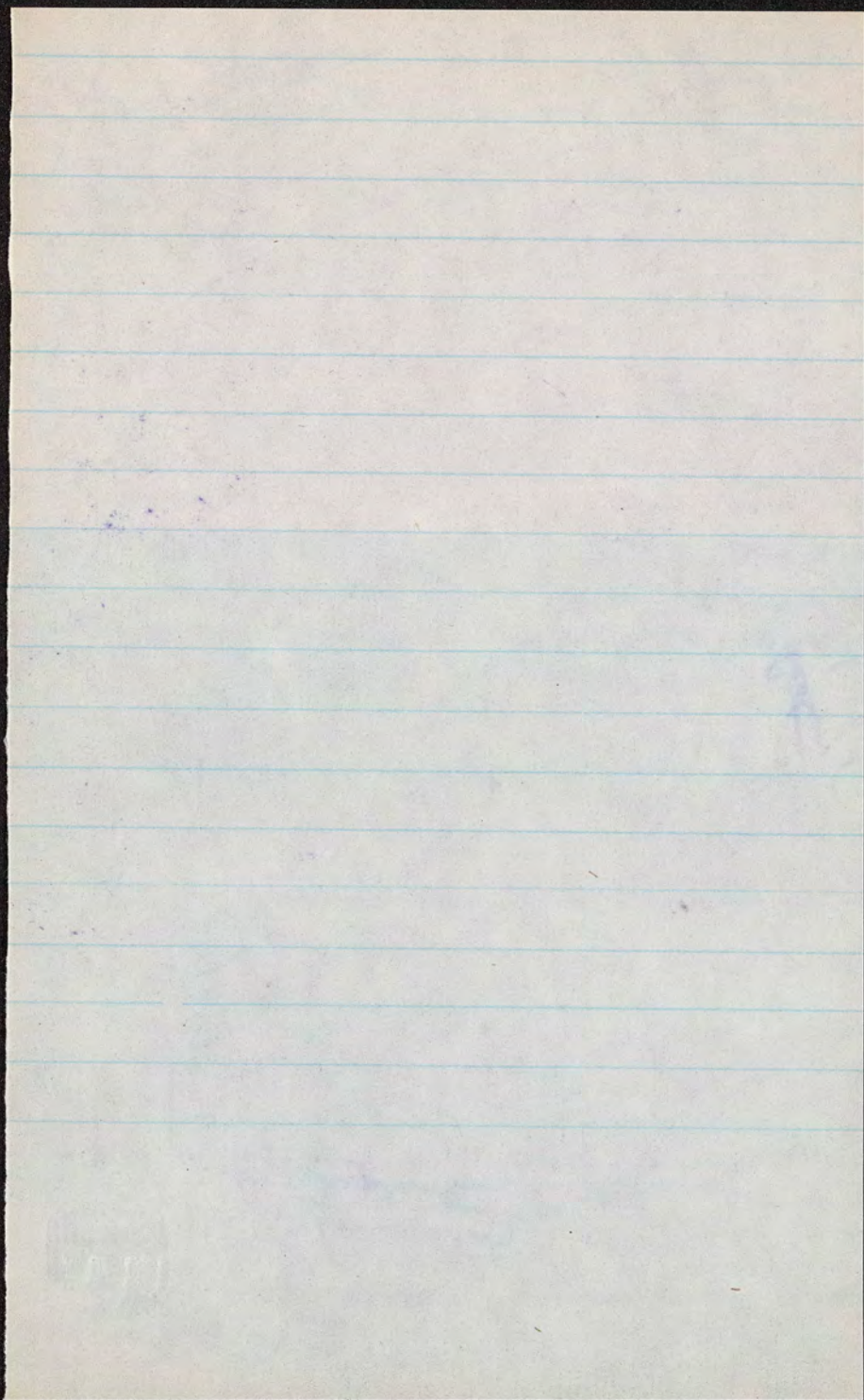




? { Cell-products build up —  
cell-life consumes —

Analogy of  
varicella & vaccinal virus  
is against "organism" necessity.

Some chemical changes are  
vital, formative  
Others disorganizing  
digestion of the first  
excretion  
fermentation  
putrefaction  
(silica, gastric juice)  
(pancreatic secretion)  
Cells may act on both, or cell-products  
of the second.





Possible hypotheses -

- a. Chym catatypis alone
- b. Bioplasts of Beales

1. Organisms accidental & impotent coincidents only & scavengers!
2. Parasitic, consuming - Wood & Toxmod
3. Poison (ferment) producing
4. Carriers of poison.

Toxicolalia  
Carmichael  
Pastor  
Vulgaris?

Facts of vaccine.  
& its analogues  
Buchner  
Pastor, Law

a. Specific difference of organisms, not in the morphological similar or identity.

b. Mutual convertibility of dith.

Negeli, Béchard, Grant  
Cohnheim denies this. B. Sanderson?

Buchner, Conversion at least of mild  
into infections Pastor, Law  
Wernich Koch Grant Wood  
Thorne Wilks  
Townsend Buchner B. Sanderson Emmelfield Sequid





fermentation, putrefaction, and  
disease-infection, are then clearly  
allied processes - having no doubt an  
analogy explanation. [Digestion, plus?]

Leave 2 pages space for this, instead of  
Erm Theory. (Huxley). Copying it

Historical stages:

Stahl proposed chemical theory of ferments  
about ~~beginning of 17th century~~ <sup>some 2 centuries ago</sup>

Kaboni, Cagniard de la Tour & Schwann  
later, after the microscope had come to be skillfully applied,  
discovered yeast-plant -

Libig, chem. theory -  
Pasteur, Vital -

Helmholtz should experimentally  
test the substance which causes  
fermentation & putrefaction. Does  
not go through membrane -

Schroder & Dusch proved that  
it was detained by cotton wool;  
& Pasteur found particles on the  
cotton wool - that these, when  
planted in a suitable medium, grew.  
(Bottles were kept sour; canned meats  
& vegetables kept; yet whole rotten eggs  
in a basket not their neighbors.)

Darwin's gangrene of spleen in ship,  
bacteria -  
Buhl, Huter, Tomasi, Cortal, Kasiloff  
& Letanin(?) veg. organism in diphtheria -

Hauptmann & Kircher (1650) (Linné) 1757  
(middle of 17th century)

proposed idea of epidemic diseases  
being caused by mias. atmosph.  
Hensle of Berlin, 1840 - germs  
& Sir H. Holland - J. Mitchell  
Lister, air-germs causes of  
suppuration of wounds  
about 1855-60

Chamman, & B. Sanderson -  
vaccine particles, - micrococci

1/20000 of an inch -  
Curtis & Satterthwaite - type by filter.  
Haller - polymorphous (plasmophorous)  
of common fungi - micrococci &c

Beale - living & viable forms  
detached from body - <sup>germinable matter</sup> bioplasts  
Klebs, pyæmia & septicæmia caused  
by a veg. organism - "microsporon septicum"  
over



Ergot of Rye  
Puccinia, parasite of wheat  
Oidium Tuckeri of grapes -

Peronospora infestans, of potato vines -

Botrytis Bassiana  
muscadine of silk-worm.

Empusa Musca of flies -

Panhistophyton (Paster) of pebrine in silkworms

These fungi, without chlorophyll,  
live only on organic matter -

(Schizomycetes &)

Saprophytes (putrefac. plants)

Chionyphe Carteri - mycetoma  
or Madura-foot.

Fungus-emboli. <sup>Reinisch, Baumgarten, 1875</sup>  
<sup>Elephantiasis, 1850</sup>  
Zanker: - a case of Thrush

(Oidium albicans) - fungus-mycelium  
penetrating vessels of muc. membrane  
& getting to brain, causing numerous  
small abscesses there!

Sepsis!

B. W. Richardson

"Sepsis" - coming  
with acids, compounds retain poisonous properties!

Acarus (Sarcoptes hominis)  
of itch

& Trichomon, disease producers

Achorion - <sup>the name</sup> of tinea &c

Lucilia hominivorax of Cayenne

Bilhyria hematobia -

also - (see slip)  
Filaria sanguinea hominis

Oidium albicans of throat

& Achorion, trichophyton Microsporum  
of tineaoid skin diseases.

Bacteria are considered vegetable

(bacteria, protista of Haeckel) - getting

Nitrogen from ammonia, & carbon from

tissues or fluids (or decay products)

of other lower organisms.

Plomaines, 1881 -



If this happens to an article that is to be plated, the only remedy is to remove it by a vigorous application of the scratch brush, and to commence again ; for no good work can be done over this black coating.

Electro-gilding is done in the same manner as electro-plating, using a solution of cyanide of gold, instead of silver, and a gold plate in place of the silver. The gilding of the interior of cups and similar articles is accomplished by placing them upon a metallic plate which is connected with the zinc plate of the battery, filling them with the gold solution, and then dipping into them a slip of gold which is connected with the other pole.

VEGETATION INSIDE AN EGG.—A foreign journal states that "Professor Panceri made an interesting communication to the Institut Égyptien at its meeting in December, on the cryptogamic vegetation which he had found within the egg of an ostrich. This egg had been given him at Cairo, and was still fresh, the air space having not even been formed. He soon, however, noticed the appearance of dark blotches within the shell, and having broken it open to ascertain the cause, he found that they were produced by the growth of minute fungi. Instances of a similar kind had already been studied by him, and he had communicated the results to the Botanical Congress held at Lugano in 1859. The



# Bacteria

## THE MEDICAL NEWS AND LIBRARY.

VOL. XXXIII.

MAY, 1875.

No. 389.

### CONTENTS.

|                                                                                                                                                    |           |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| LECTURES.                                                                                                                                          |           |
| Abstract of a Lecture on the Relation of Bacteria to the Chemical and Physical Processes which constitute the Life of the Higher Animals . . . . . | 65        |
| CLINICS.                                                                                                                                           |           |
| Clinical Remarks on the Simulation of Dislocation into the Axilla after Union of Fractures through the Tuberosities of the Humerus . . . . .       | 72        |
| MEDICAL NEWS.                                                                                                                                      |           |
| Domestic Intelligence—Posterior Staphylo-<br>ma, etc. . . . .                                                                                      | 73        |
| Impaction of Coin in Oesophagus . . . . .                                                                                                          | 74        |
| American Medical Association . . . . .                                                                                                             | 74        |
| Medical Graduates in 1875 (continued from<br>p. 56) . . . . .                                                                                      | 74        |
| University of Nashville and Vanderbilt Uni-<br>versity . . . . .                                                                                   | 74        |
| Hospital of the University of Pennsylvania . . . . .                                                                                               | 74        |
| Medical Department of Harvard University . . . . .                                                                                                 | 74        |
| Appointment . . . . .                                                                                                                              | 74        |
| STOKES ON FEVERS . . . . .                                                                                                                         | 16 PAGES. |
| Bellevue Hospital Medical College . . . . .                                                                                                        | 74        |
| Association of Ex-Confederate Surgeons . . . . .                                                                                                   | 74        |
| Obituary Record . . . . .                                                                                                                          | 74        |
| Foreign Intelligence—The Germ Theory of<br>Disease . . . . .                                                                                       | 75        |
| Action of the Septic Poisons on the Pro-<br>duction of Fever . . . . .                                                                             | 75        |
| Action of Salicylic Acid in Bacteria . . . . .                                                                                                     | 76        |
| Bromide of Potassium in Migraine . . . . .                                                                                                         | 76        |
| Ergot in Acute Mania and other Hyperæmic<br>States of the Nervous Centres . . . . .                                                                | 77        |
| Removal of Goitre; Previous Ligature of<br>Arteries . . . . .                                                                                      | 77        |
| Dangers of Forced Taxis . . . . .                                                                                                                  | 77        |
| A New Point in the Diagnosis of Ovarian<br>Disease . . . . .                                                                                       | 77        |
| A New Form of Glycosuria . . . . .                                                                                                                 | 78        |
| The Drawbacks of Esmarch's Ischemia . . . . .                                                                                                      | 78        |
| Death from Chloroform . . . . .                                                                                                                    | 78        |
| Mode of Death from inhaling Nitrous Oxide . . . . .                                                                                                | 78        |
| Mistaken Identity . . . . .                                                                                                                        | 78        |
| Dislocation of Humerus Reduced after Five<br>Months . . . . .                                                                                      | 79        |
| Hypospadias and Epispadias . . . . .                                                                                                               | 79        |
| International Medical Congress . . . . .                                                                                                           | 79        |

### LECTURES.

*Abstract of a Lecture on the Relation of Bacteria to the Chemical and Physical Processes which constitute the Life of the Higher Animals.* By J. BURDON SANDERSON, M.D., Prof. Phys. in Univ. Coll.

As introductory to my subject, I must give a short account of the natural history of the organic forms which we now, following high botanical authority, group together under the term bacteria. Secondly, I shall consider the question of their general influence on the processes of life of the higher animals, and the mode in which this is exercised. This will prepare us for discussing the question how far they act as morbid poisons, or as the

vehicles of such poisons, or are characteristic of specific diseases. I would remind you that the question we have before us is not that of the origin of bacteria, nor that of their place in nature, but the more restricted one of their influence on ourselves, and on the lower animals whose life, whose health, and whose diseases are but the counterparts of our own.

It is because they are constantly invading our bodies and attacking the living protoplasm by which the work of life is carried on in our tissues, that we, as pathologists, take an interest in their natural history. It is for this reason that questions relating to them, which at first sight seem recondite and remote, have a direct and immediate bearing on practical

*Published monthly by HENRY C. LEA, Nos. 706 & 708 Sansom Street, Philadelphia, for One Dollar a year; also furnished GRATUITOUSLY to all subscribers of the "American Journal of the Medical Sciences," who remit the Annual Subscription, Five Dollars, in advance, in which case both periodicals are sent by mail free of postage.*

*In no case is this periodical sent unless the subscription is paid in advance.*

VOL. XXXIII.—5

Read over before Lecture & put aside



questions. For if, as I shall endeavour to show, they are constantly present to us—constantly mixing up their life with ours—we cannot wisely remain ignorant of their nature. We do not aspire or profess to be botanists; but, if plant-forms and plant-life associate themselves with the very processes which it is our business to study, we must become botanists for the occasion.

In the short introductory account I shall give of the forms of bacteria, I shall follow Professor Cohn (*Ueber Bacterin, die kleinsten lebenden Wesen*, Berlin, 1872), as being the only botanist of high authority who has given special attention to the subject. For the remainder of what I have to say, I am myself answerable. I shall, however, make it my endeavour not to vindicate the views which I have advanced myself, or which others may have attributed to me; but to place before you a general view of the work that has been done during the four years which have elapsed since the subject began to occupy the serious attention of pathologists.

*Morphology and Natural History of Bacteria.*—The first fact that I shall advance with respect to bacteria is, that they are the smallest and least organized of all living beings. As regards size, it is best to judge by comparison with objects with which we are microscopically familiar. The most common rod-like forms are in length about one-third of the width of a blood-corpuscle; *i. e.*, about  $\frac{1}{3000}$ th of an inch—so small that, if we examine a liquid containing them, with the ordinary magnifying powers used for histological observations, we can scarcely be said to see them to any practical purpose. It is necessary to have recourse to the best microscopes and the highest powers, if it be desired to observe them in such a way as to arrive at useful results.

What grounds have we for stating that they are the lowest organisms? One is, that they present only very slight differentiation of parts; but in this sense they are certainly not simpler than many other forms that might be referred to. The chief ground for the statement lies in this, that they are much less *specific* in their characters—much more under the influ-

ence of the conditions under which they originate and are developed—than organisms of any other class. Just as in the higher animals and in man himself we call those functions lowest which are most completely automatic—*i. e.*, most completely under the guidance of known conditions—so also, as regards form, we recognize that while all animal and vegetable forms, even the highest, are moulded by circumstances to fit their places in the economy of nature, this moulding power—this adaptation of form to circumstance—becomes more and more obvious the lower we descend in the scale of development.

The next fact relates to the *habitat* of bacteria—to the medium in which they live—water. They inhabit water either as such in the ordinary sense, or in the various conditions recognized as *moisture*, whether occurring on damp surfaces or as filling the interstices of solid bodies, which bodies, when so impregnated with water, are said to be damp. Those who are familiar with chemical work know that this quality of dampness goes a great deal further than the popular notion of it; that many things ordinarily called dry yield, when subjected to the drying processes commonly used in the laboratory, evidences of being really moist. Consequently, moisture, regarded as a limiting condition of bacterial life, is a very wide and comprehensive one.

From this statement, it must not be understood that bacteria do not exist in the atmosphere. But their existence there in an active form strictly depends on moisture. They attach themselves, without doubt, to those minute particles which, scarcely visible in ordinary light, appear as motes in the sunbeam, or in the beam of the electric lamp. It is by the agency of these particles that they are conveyed from place to place.

Notwithstanding that the word bacterium means a rod, and that many of the forms to be immediately referred to are not rod-like, I am obliged to use it, because it is used by others as a general term for the whole group of organisms known to botanists as *Schizomycetes*.

Bacteria have, as a rule, two states of



existence—a state of activity and a state of rest. When a liquid teeming with bacteria in the active state is observed under the microscope, the attention is so riveted, that it is an effort to take away the eye from the instrument. The movements have been often described. In the case of rod-shaped bacteria, the axial movement in which the rod advances or retreats in the line of its axis, the direction being frequently reversed, is the most common. This kind of locomotion occurs often by fits and starts, the body remaining in the intervals quite still, or assuming a pirouetting or spinning movement. In all rod-like bacteria, it is probable that the progressive or axial movement is associated with rotation, for, in observing the motion of vibrios, it is easy to see that they, in progressing, twist round the axis of the spiral. When this is the case, it looks as if the filament were executing a wriggling motion, *i. e.*, as if its body were contractile; but this is obviously deceptive. The mechanism of the motion is as little understood as those of *Oscillatoria*, which it closely resembles. It must be carefully distinguished from the passive motions which are exhibited by all particles of size comparable to that of bacteria, when suspended in a liquid of which the density does not differ very widely from their own. We shall find afterwards that certain forms of bacteria appear to be motionless in all stages of their existence.

Rod-bacteria multiply by repeated bisection. This mode of multiplication goes on continuously, the rate varying with the conditions of life, and particularly with temperature. Under favourable circumstances, it is enormous. From actual measurement of the time which elapses in a single case between a bisection and the division of each half into quarters (in other words, of the longest time that a single bacterium remains without dividing), it has been ascertained that the interval in question, in common bacteria, is about an hour. This being the case, it is easy to compute that every single bacterium must produce 16,777,220 individuals in twenty-four hours. Putting it otherwise, the progeny of a mass

of bacteria weighing  $\frac{1}{2400}$  grain would, at the end of a day, weigh a pound.

In the largest forms of bacteria, it can be made out that each individual consists, not, like an animal cell, of one sort of living substance,<sup>1</sup> but, like a plant-cell, of a protoplasmic interior inclosed in an envelope of cellulose, by virtue of which the bodies of bacteria are enabled to resist the action of reagents, particularly weak acids and alkalies, which dissolve protoplasm. In those bacteria which separate from each other, as soon as they assume the form of distinct individuals, the more stable external part presents itself as a mere envelope; but when, as very usually happens, the progeny which results from a continuous succession of divisions remains in a state of aggregation, the envelope appears to become identified with the "gelatinous" matrix by which they are held together. This observation was made more than twenty years ago by Cohn, who devised the term *zoogloea* as a general designation for the clumps, or, as Hallier calls them from the mode of aggregation above described, "colonies." You will find that this term is now very constantly used by writers on the subject, for these gelatinous masses occur under a great variety of circumstances. In form, they are mostly either spheroidal or membranous, and have this one characteristic which is noteworthy, that their structure is such as to indicate that they grow at their surfaces or margins, not interstitially. Thus, for example, in the spheroidal forms, which, as seen under the microscope, present a more or less circular outline, it is obvious that the multiplication of individuals is most active near the edge. The membranous forms, on the other hand, often present a growing outline in one direction, a disintegrating one in the other.

We are not able to state that the process of repeated division into two is the only one by which bacteria come into ex-

<sup>1</sup> In using the expression "one sort of living substance," I must guard against being supposed to mean that any kind of living protoplasm is homogeneous. Hyaline though it may appear, we are not able at present to assign any limit to its complexity of structure.

n. B.  
in biology -  
versus Huxley's  
bacteria



istence. When we watch a liquid in which they are beginning to appear as if spontaneously, where none were visible a few minutes before, all that we can make out is, that a nebula presents itself; and that here and there, in the previously homogeneous liquid, particles exist which, although their form is at first indistinguishable, eventually become recognizable as bacteria. As to the way in which this happens, it is difficult to speak positively, for with reference to it no evidence is admissible excepting such as is founded on direct observation—i. e., on watching the process in a single instance for many hours—fixing the eye on a single bacterium, a thing weighing two-billionths of a grain, and measuring one-eighth-thousandth of an inch, and not quitting it till it divides and divides again. Klebs has attempted to do this, but I will not detain you with an account of his researches.

From what I have said as to their structure and ordinary mode of multiplication by division, it is obvious that bacteria resemble plants, and particularly the Oscillatoriae, more than animals. The proof that they are plants rests on what is known as the nature of the chemical processes which constitute their life, to the consideration of which we must now pass.

How do bacteria act on the medium in which they live? On this subject, we owe the foundations of our knowledge to Pasteur. The first fact is, that bacteria act on the media in which they live, not as animals, but as plants. Like plants, they derive the nitrogen that they use to build up new albuminous compounds, not from previously existing albuminous compounds, but from ammonia. Like other colourless plants, they derive their carbon apparently from any carbon-compound except carbonic acid, by dissociation of its elements. Like plants, they require certain inorganic constituents to be present in their soil, particularly potash and phosphoric acid.

As regards the assimilation (or fixation) of carbon, Cohn's researches have very materially advanced our knowledge since the publication of Pasteur's work. It was

obvious that bacteria did not decompose carbonic acid under the influence of sunlight, by the same wonderful process by which that dissociation is performed by green plants. This they could not do in the absence of chlorophyll. But in this respect they were not in any different position from the fungi, or even from the colourless phanerogamic parasites—as, for example, the bird's-nest orchis.

Pasteur's investigations related, not to bacteria or to the organic forms which are associated with the process of putrefaction, but to the yeast-plant. With reference to that organism, he proved that it derives its nitrogen directly from ammonia. He proved at the same time that the cellulose of which the external part of the yeast-cell consists, is derived from grape-sugar, and cannot be formed in the absence of that body. He did not extend the application of these facts to the organisms of putrefaction; but it came to be assumed that what was true of the yeast-plant would also be true of the others—viz., that, although ammonia was a sufficient source of nitrogen, some hydrocarbon must be present to yield carbon.

Cohn showed this assumption to be a mistaken one, by applying to the organisms of putrefying liquids the same mode of investigation that Pasteur had before applied to the yeast-plant (Cohn, *Beiträge zur Biologie der Pflanzen*, Heft ii. pp. 191–202). That method (since known as the method of cultivation) consists in first finding a liquid of known chemical composition in which the plant to be investigated grows vigorously, and then gradually modifying the composition of this liquid by the elimination of one after another of its ingredients, until at last a mixture is obtained in which the greatest possible simplicity is combined with the greatest possible adaptedness as a soil to the requirements of the particular organism; adaptedness being judged of by rapidity of growth. Such a liquid, as regards the yeast-plant, is that known as Pasteur's cultivating fluid. Its composition stands for the fact that sugar and certain crystalline salts are all that is wanted for the nutrition of the yeast-plant.

In the earlier experiments as to the



cultivation of bacteria, *e. g.*, in those which I made in 1871, it was assumed that Pasteur's liquid would also be the most suitable liquid for bacteria. During the same year, however, Cohn, observing that, although bacteria flourished in it abundantly, it was very difficult to prevent the growth at the same time of the yeast-fungus and of penicillium, *i. e.*, common mould, left out the sugar, and found that the bacteria flourished better without it than with it. His next step was to substitute for the solution yeast-ash (a material which is troublesome to prepare) a solution containing the required salts in about the proportion in which they are ascertained to exist in the ash of the yeast-plant. The liquid which we now use as a "cultivation liquid" for bacteria is prepared by dissolving half a percentage each of potassic phosphate and magnesian sulphate in water having a trace of calcic phosphate in suspension,<sup>1</sup> and then adding as required a further percentage of ammoniac tartrate, and of course boiling the mixture. In this liquid, bacteria grow rapidly—a fact which proves not only that they are able to take their nitrogen from ammonia, but that they can also derive carbon from the tartrate—the only carbon-containing body which is present. Although, however, it supports the life of bacteria so completely, that they not only subsist in it, but multiply with enormous rapidity under favourable conditions of temperature, it never originates them, if it have been boiled. It can, indeed, be very easily kept for indefinite periods without change, remaining absolutely transparent and barren, provided that care be taken to protect it from contamination. It is, however, much better practically to keep the solution of inorganic salts, adding the tartrate in the proper proportion for each set of experiments.

In order to determine the development of bacteria in a liquid of this kind, all that is necessary is to touch it with a

<sup>1</sup> The calcic phosphate is best prepared by precipitating solution of calcic chloride with common sodic phosphate, taking care that the former shall be in excess. This precipitate splits on boiling into a soluble and an insoluble phosphate.

"damp" surface—a glass rod, a thread of cotton or silk—*any object which, having been exposed to the atmosphere, has not since its exposure been dried by heating it to a sufficient temperature.* The result may be equally well attained by allowing a particle of dust or a drop of water, or common distilled water, to fall into the liquid. All these liquids, although they contain no organic forms which can be recognized even with the aid of the highest powers, yet contain that which, when added to solution of ammoniac tartrate, determines its decomposition, and the building up of its nitrogen and carbon into higher combinations—in a word, vegetation. I call this process quasi-spontaneous. It is not spontaneous, for this simple reason—that it is dependent on conditions which are so far known, that it is possible to control them with perfect certainty.

I may add, that it was by experiments such as those to which I have just been referring that I was enabled to show, in 1871, that moist surfaces and particles of solid material in suspension in the air play the chief part in the propagation of bacteria; *i. e.*, in the conveyance of the material out of which they spring from one soil to another. This inference has now been confirmed—I think I may venture to say, established—by very numerous observations.

*Influence of Bacterial Vegetation on the Process of Putrefaction.*—In referring to Cohn's classification of the organisms which constitute the group of Schizomycetes according to their form, I stated that this classification was chiefly of value for the purposes of description, and that the exact similarity of any two forms cannot here be taken as evidence of their organic continuity any more than their dissimilarity affords indication of the absence of intimate relation between them; for the influence of environment over organisms such as bacteria is so great, that it seems as if it were paramount; the surrounding conditions claiming a power not merely of moulding the organisms into conformity with themselves, but even of originating it.

For reasons on which it is unnecessary to enter here, we do not admit the latter



part of this claim; but it is a principle of fundamental importance in dealing with the question we have now before us—that of the agency of bacteria in septic processes—that the influence of circumstance over form is practically so powerful, that, in considering the relation of bacteria to septic processes, we shall do best if we regard the appearance of particular forms as mere links in the chain of events of which the process consists.

To illustrate this, it will not be a waste of time to refer for a moment to the singular fact discovered a short time ago by Professor Cohn, that, under conditions as yet quite unknown, colouring matters come into existence in albuminous liquids when left to themselves at ordinary temperatures; and that this development of pigment is associated with the development of bacteria. Not long ago, having left a "solution" of ordinary egg-albumen in a cupboard in the laboratory, I found that the liquid, which had no putrid odour, possessed an intense indigo-blue colour. Being acquainted with Cohn's observations, I at once guessed what had happened, and found, on microscopical examination, that the blue scum on the surface of the liquid consisted, first, of colourless bacteria, resembling in form those met with in septic liquids; and, secondly, of blue pigment-particles of extreme minuteness, which appeared to be imbedded in the interstitial gelatinous material by which the organisms were surrounded. The process continued for some time; but eventually the liquid was inadvertently allowed to dry. On inoculating a similar albuminous liquid with the dried residue, I was unsuccessful in reproducing the process; but Cohn, who came upon several of his colour-producing bacteria in a similarly accidental way, was able to perpetuate the process by repeated transmissions.

I mention this observation merely to illustrate what I have been saying as to the relation between the two collateral processes—between the vegetation-process, on the one hand, and that of the formation of a characteristic chemical product, on the other. Here we have no

sufficient reason for saying either that the production of colour is the cause of the development of bacteria, or that the bacteria are the agents in the production of the pigment. All that we observe is, that the two phenomena begin, continue, and end together; we regard them, therefore, as collateral characteristics of one and the same process.

As the result of innumerable observations, we know that, as a rule, those changes in albuminous liquids, which we familiarly recognize as constituting putrefaction, are accompanied by the presence in such liquids of characteristic vegetable organisms. We also know that the two processes—viz., the chemical changes and the rapid vegetation—go on *pari passu*, and that the same circumstances which favour the growth and multiplication of organic forms also favour putrefaction.

As to the meaning of these facts, there is some difference of opinion even among competent naturalists. All are agreed that the relation between the chemical process and the vegetative process is an intimate one: but somewhat discrepant views prevail as to its nature.

The fundamental experiment by which the intimacy of the association is proved is this. When a tube or flask is partly filled with water containing albuminous matter in solution or suspension, and subsequently boiled for a sufficient length of time, and closed hermetically during ebullition, no putrefaction occurs under any circumstances; but if, after such a tube has been heated and allowed to cool, a drop of distilled water, or any other exposed fluid, be added before the tube is again sealed, putrefaction follows, provided that the preparation is kept at the ordinary temperature.

As I have already hinted, there are some naturalists who would not agree to the terms in which I have stated this result. They would rather substitute for the words "under any circumstances" some such expression as "in 9999 cases out of 10,000." For our present purpose, it makes little difference whether the statement be accepted absolutely or not. But there is another point relating to the origin of bacteria in albuminous liquids of



much greater importance, which the discussion about abiogenesis is apt to conceal or throw unduly into the background. It is a question which arises directly out of the results of the "cultivation" experiments to which I have just referred. These experiments show that bacteria are able to derive the whole of the carbon they require for the building up of their protoplasm from compounds of great chemical simplicity, which have never formed part of any living organism, and seek for no higher source of nitrogen than ammonia. This being the case, it is more than probable that, when the growth of bacteria goes on in association with septic processes, they derive their nitrogen and carbon, not from the albuminous compounds themselves, but from the ultimate products of their disintegration. This being the case, we must regard bacterial life (in so far as it consists in the building up of new protoplasm) as a process consequent on the chemical process of putrefaction with which it is associated. For disintegration must already have proceeded as far as to the production of ammonia—in a word, must have proceeded to the last stage—before the new integration could commence.

While admitting this, it is important clearly to see that the admission does not in any way render it more or less probable that bacteria are the efficient causes of putrefaction—that without which putrefaction could not take place—for there is nothing which forbids us to regard bacterial vegetation as connected (if I may so express myself) with both ends of the chemical process of disintegration of putrescible material at the same time; not the shadow of an objection to the assumption that, on the one hand, bacteria derive material for the integration of their protoplasm from the products of disintegration of the soil in which they flourish, and, on the other, that they produce the ferment by which disintegration is determined. There is nothing, in short, against their standing to the chemical process at the same time in the relation of antecedent and consequent.

If it should seem to you that this is a too vague way of dealing with the subject,

I would ask you to consider that the question is one in respect of which caution is more than usually necessary; for, while theoretical explanations offer themselves freely on every side, experimental investigation is beset with peculiar difficulties. As regards the main question, that of the agency of bacteria in producing putrefaction, there are two extreme views, which are both clearly mistaken—the one which asserts that they have nothing to do with the septic process; the other, that the chemical phenomena of putrefaction are the mere accidents of a peculiar kind of vegetation. The truth lies without doubt between these two opposed theories; but it is not to be got at by an ingenious reconciliation of the one with the other, but by honestly opening the mind to the facts as they stand, in the confidence that, if they are allowed fair play, they will eventually shape themselves into a general conception, in accordance with their true relation. So long as uncertainty exists, there is nothing to be so much avoided as that sort of clearness which consists in concealing difficulties and overlooking ambiguities.

[Since this lecture was delivered, an important contribution to the elucidation of this question has been made by Dr. Hillier of Berlin (*"Der Antheil der Bacterien am Fäulnisprozess," Centralblatt, No. 54, Nov. 14, 1874*). Starting from the fact observed by himself (to the accuracy of which I can testify from my own observation), that, in the "alkaline fermentation" of urine, the splitting of urea into ammonic carbonate is not in relation with the abundant development of septic bacteria in the liquid, he made experiments which showed that in urine, bacteria do not derive their nitrogen from urea, but from other sources; and that, if ammonic tartrate be added to urine, the multiplication of bacteria goes on with great activity without any diminution of its acid reaction, *i. e.*, without any decomposition of its urea. From this result, he proceeds to similar experiments as to the influence of bacteria on egg-albumen. Having first ascertained, by careful observations, the fact familiar to the housewife that fresh eggs "turn" when



put into the same basket with rotten ones, and can therefore be infected through the air, he injects a "cultivation liquid," containing bacteria, but not putrid, into the albumen of a fresh egg, with the aid of a subcutaneous syringe. The egg remains unaltered. He therefore thinks it impossible to identify multiplying bacteria with the "septic ferment;" with reference to which he thinks that the experimental investigations of the last few years have proved nothing more than "it is a particular substance which either exists suspended in the air, or adheres to objects, and that it can be separated from the air by filtration, and can be destroyed by the temperature of ebullition." With this final statement of the case I perfectly agree, and am not at all disposed to quarrel with him because he goes on to suggest that the "particles" of which the septic ferment consists are not living beings, but *Protéinsplittchen*.]—*Brit. Med. Journ.*, Jan. 16, 1875.

## CLINICS.

*Clinical Remarks on the Simulation of Dislocation into the Axilla after Union of Fractures through the Tuberosities of the Humerus.* By J. HUTCHINSON, Esq., Surgeon to London Hospital.—Mr. Hutchinson devoted this lecture chiefly to an explanation of the resemblances and differences between unreduced sub-coracoid dislocation of the humerus and united fractures of the bone through the parts above the surgical neck. The remarks were elicited by the case of a middle-aged man who was brought into the theatre. Several months ago this man had received a severe injury to his right shoulder. The surgeon who attended him in the first instance thought that the parts were only severely bruised. Three weeks after the accident he was told, at a provincial hospital, that the bone of the arm was fractured near the shoulder; and again, some time later, after he had left the hospital, the diagnosis of unreduced dislocation of the humerus was made. Subsequently an attempt at reduction under chloroform was made. He was next sent by his surgeon to the London Hospital,

to know whether anything further could be done to put it in its place again. Some of the signs of sub-coracoid dislocation were absent, while those that were present existed in only a modified form; thus, while there was no inability to bring the elbow to the side, and no stretching of the deltoid muscle, there was considerable flattening of the shoulder, with marked hollowness under the acromion and a prominence of bone in the axilla. The last two symptoms were, however, less marked than in cases of dislocation; and while the altered outline of the shoulder was in great part due to atrophy of the deltoid, the prominence in the axilla was caused in part by general thickening of the upper part of the humerus, but chiefly by a partial displacement of the head subsequent to the fracture.

Mr. Hutchinson conjectured that the bone was broken irregularly through the tuberosities, perhaps comminuted; that the shaft was pushed upwards slightly, and had tilted the head of the bone in such a way that its articular surface thenceforth looked inwards. Such a displacement would produce a slight rounded prominence in the axilla, but would not prevent the arm from being brought to the side; it would also produce, after union, considerable general thickening of the upper part of the humerus. The atrophy of deltoid, and consequent simulation of the acromial prominence present in dislocation, was to be accounted for by direct injury to the circumflex nerve.

The wasting of the deltoid, and therefore the flattening of the shoulder, do not come on until many weeks after an injury of this kind; consequently, it is generally when the patient goes to a fresh medical man two or three months after the accident that the diagnosis of unreduced dislocation is made. Mr. Hutchinson believes that this mistake (aided as its commission is by the bony prominence in the axilla) is not unfrequently made, and that thus the reputation of the surgeon who first saw and treated the case is often seriously damaged. He related a case in which he had, he believed, made the mistake in question. An attempt at reduction



etc., to which he made important additions, he was a large contributor to the medical journals, particularly to the *North American Medical and Surgical Journal* and to the *American Journal of the Medical Sciences*. He was an early advocate of the temperance movement, and in conjunction with the late Dr. John Bell, edited a journal (*The Journal of Health*) devoted mainly to the promotion of that cause. For upwards of fifty years he was engaged in extensive practice, which he was obliged to relinquish about four years since in consequence of being crippled by a fall on his hip, when he removed to a farm a few miles from the city. Until a recent period, however, he was busy with his pen, and contributed a number of valuable articles to the *American Journal of the Medical Sciences*.

#### FOREIGN INTELLIGENCE.

*The Germ Theory of Disease.*—There has recently been an interesting discussion at the Pathological Society of London, on the relation of Bacteria and Allied Organisms to the Virulent Inflammations and to the Specific Contagious Fevers. Dr. Bastian commenced by referring to the analogy which existed betwixt zymosis and fermentation, in that particles in each case set up processes which resulted in the reproduction of other particles identical with the first. He contrasted Pasteur's views with the transferred eremacausis of Liebig, inclining to the views of the latter. The contagium multiplied within the body in a manner which might be compared to organic growth and multiplication. Bacteria were not found in the blood of healthy individuals; yet, in from eight to forty-eight hours after death, they were found in abundance. He contended that bacteria had a casual connection with infection, and that they were not mere "carriers of infection," but were for the most part actual pathological products engendered within the body; that, in fact, there was a bacterial degeneration which claimed to rank side by side with fatty degeneration. After expounding his views with much skill and detail, he was followed by Dr. Burdon

Sanderson. Dr. Sanderson declined to go into the germ theory in its entirety, but confined himself to the negative facts that bacteria identical with those found in morbid tissues, might be introduced into the body without any ill effects; and to the positive facts that, in destructive inflammations, bacteria were found only in the outer zone of the disease, where it was spreading, and not in the central parts; and that in relapsing fever spirillæ were only found during the febrile paroxysm and not afterwards; and that in erysipelas and sheep-pock, the bacteria were found not in the vesicles, but in the lymphatics of the skin. These facts, he thought, were opposed to Dr. Bastian's views.—*Brit. Med. Journ.*, April 10, 1875.

*Action of the Septinous Poisons on the Production of Fever.*—Dr. B. W. RICHARDSON, in a recent lecture before the Society of Medical Officers of Health, offered a theory of the action of the poisons of contagious diseases in the production of symptoms which mark those diseases, and especially the symptoms of fever. In a lecture delivered before the same Society, in the year 1865, the author detailed his original experiments on the poisonous action of an organic substance he had obtained from sero-sanguineous fluid that had been removed by Mr. Spencer Wells from the peritoneal cavity of a woman suffering from pyæmia after the operation of ovariectomy. To this organic poisonous substance he (Dr. Richardson) at that time gave the name of septime, and he showed not only that it would communicate fatal disease to an inferior animal, but that the same disease could be communicated from the secretions of the primarily infected animal to other healthy animals in direct series. He also showed in the same research that the organic poison could be made to combine with acids so as to form salts which retained the poisonous qualities of the original substance. That a similar poisonous substance is present in decomposing blood, and that the poison can be transmitted in a series of animals, have since been confirmed by the independent researches of many physiologists, and the fact may be considered as fully

See my other clippings about Bastian's  
& Burdon Sanderson's views: transpays?



established, although great difference of opinion still remains as to the nature of the organic product, some assigning to it purely physical, others vital properties.

Dr. R. has ever since his researches in 1865 been engaged in the inquiry how these organic poisons produce their peculiar effects, and the result is to the effect that the poisons exert their deleterious action through the property they possess of setting at liberty the oxygen of the blood in undue quantities in the extreme circulation. By way of experimental demonstration, Dr. Richardson took specimens of solutions of peroxide of hydrogen, and inoculated them with points of different organic poisonous animal substances—viz., decomposing blood, pyæmic poison, pus, fibrine, and vaccine lymph. In the presence of all these bodies, oxygen began to be immediately liberated from the solution. Other organic substances—mucus, for instance—would not liberate oxygen, a fact which could be applied (as was shown by an experiment) for diagnosing mucus from purulent matter. Proceeding with his demonstration, Dr. Richardson charged blood with oxygen from the peroxide solution; then, by inoculating this blood and setting oxygen at liberty, he showed the temperature of the blood rose 4° Fahr. In his further observations, he explained that these organic disturbing substances are themselves decomposed in the process of the change they excite, and that they all seem to be derived originally either from fibrine or cellular tissue.

The conclusion arrived at, and which was advanced admittedly as a theory in its present state, is that the fever-producing poisons act in the way described by setting oxygen free in the blood in undue proportion. The theory, it was urged, explains the phenomenon of remittency. The accession of fever is due to the presence of the poison, but as the poison becomes destroyed the disturbance ceases until a new charge is locally produced and carried into the blood. The theory also explains the phenomena of those malignant contagious diseases in which death occurs very rapidly, with symptoms of asphyxia and convulsion. Here, it is as-

sumed, the liberation of oxygen is sudden and complete, and the blood so surcharged with poisonous matter that it cannot duly absorb and fix oxygen in the pulmonary circuit. Thus an asphyxia commences from the blood itself.

Some therapeutical considerations brought the lecture to a close. It was shown that certain medicinal substances, among which quinine was specially named, counteract the different poisons in their power of liberating oxygen.

Our readers will gather from this summary that a new field of inquiry on the subject of the poisons of the contagious diseases is opened by these researches. That the inferences drawn support the physical side of the question may naturally be expected, coming as they do from an author who for so many years has been one of the most prominent exponents of the physical theory of contagion.—*Lancet*, April 3, 1875.

*Action of Salicylic Acid on Bacteria.*—Dr. LUDWIG LETZERTZ has lately tested the effect of salicylic acid on bacteria and micrococci, by placing under the microscope portions of fluid containing these organisms in abundance, and allowing solutions of salicylic acid to come into contact with them. He used solutions of four degrees of strength; viz., one part of salicylic acid and one of spirit, in 120, 90, 60, and 40 parts of water. The first two (the weaker solutions) arrested the movements of the bacteria gradually; while, with the two stronger solutions, the arrest of movement was instantaneous. He has used salicylic acid locally and internally in two cases of diphtheria, he thinks with good effect; but he observes that more extensive observations are necessary in order to determine its value in this disease.—*Brit. Med. Journ.*, March 6, 1875.

*Bromide of Potassium in Migraine.*—One of the essential characters of idiopathic migraine is its tendency to periodicity. This periodicity may be variable, and is often monthly. The migraine is always at first hemispherical, and is then also accompanied by a peculiar sense of heaviness of one of the ocular globes or



plained if the infectious material is conceded to be of a vegetable organic nature, the germs of which do not flourish under all circumstances, but only where they find an appropriate soil.

"It must be conceded, however, that so far as most of the forms of bacteria are concerned, investigation shows that if they are not received in too overwhelming quantity the *healthy* organism offers them an almost absolute resistance. Proof can be adduced in support of this; besides, there are certain bacteria which are injurious only when their invasion occurs in an already disturbed locality. Proof also is available in the case of many diseases for the assertion that *those only are attacked by the disease who were sick already.*"

In concluding this article, which, from the circumstances of the case, is brief and imperfect, and which, from the mass of material to be examined, must necessarily often appear to a certain degree undigested, we must refer the reader desirous of further knowledge of the matter to the articles quoted, and also to a lecture by Moritz Kaposi, published in the *Vierteljahresschrift für Dermatologie und Syphilis*, 1874, p. 55. This article is accompanied by a plate giving admirable representations of the principal varieties of disease-organisms. Dr. Stimson's article, which is perhaps more accessible, is also accompanied by a very good plate.

---

## REVIEWS AND BOOK NOTICES.

ON THE ADMINISTRATION AND VALUE OF PHOSPHORUS.  
By E. A. KIRBY, M.D., M.R.C.S., Esq. Philadelphia, Lindsay & Blakiston, 1875.

This pamphlet of over fifty pages is very readable, contains much asseveration and explanation as to the value of phosphorus in various conditions of nervous exhaustion, but puts forth very little that is at once new and valuable. Its *raison-d'être* appears to be the peculiar preparation which its author invented, and which is prepared at the laboratory of H. & T. Kirby & Co.,—this pilula phosphori mollis seemingly affording the only perfect method of exhibiting the drug that ever has been or will be produced by human ingenuity. The subject of the administration of phosphorus is certainly very important, and the desire at the same time of doing good and advancing the fortunes of self or family is no doubt a laudable one, but in therapeutic writing the result is not apt to be especially unbiassed and trustworthy. Therefore we advise our readers to season their reading of the brochure with at least a grain of salt. If the pills really contain the metalloid unoxidized in a diluent favoring solution, they must be good; we suppose they are good. Whether they are better than all other forms of administration is more doubtful; probably they resemble closely the preparation of Prof. Percy, of New York, in which the drug is dissolved in cacao butter and coated with gelatin. After reading the pamphlet, we confess, it still seems to us wisest to eschew all pills of phosphorus, although they have the great advantage of tastelessness, because they are liable to vary in the amount of the remedy contained in them, and to undergo oxidation and deterioration by age. The oleum phosphoratum of the Prussian Pharmacopœia, which has been much used, is undoubtedly very nauseous; but if to a saturated solution of phosphorus in chloroform an equal amount of spirit of camphor be added, and the



death. The respiration was scarcely perceptible; the pulse from 38 to 42, very feeble. Slight indications of intelligence still remained. On auscultation, coarse râles were heard. The belly was soft, the liver normal, the spleen very large. M. Jousset diagnosed it as a case of malarial fever of bad type; and he immediately endeavored to give the patient some quinine, but vomiting was induced, and syncope. Having previously had a successful case, he at once proceeded to inject a solution of hydrochlorate of quinine into the trachea. He inserted the trocar of a Pravaz' syringe into the middle of the trachea, between the first and second cartilaginous rings. A little difficulty was experienced, as the thyroid gland was large, and he only satisfied himself that the point was free by blowing through the canula. The pulse was now 31. No effort at coughing was made, and he thought she had succumbed. Five minutes after, the pulse was 40. The limbs were now covered with warm flannel, and light friction made. In ten minutes the pulse had risen to 45, and an involuntary evacuation occurred. She murmured some words. In thirty-five minutes she asked for some drink. She complained of intense pain in the head, which, however, was not hot. In an hour the pulse had risen to 96; and shortly afterwards she was in her ordinary health.—*London Lancet*.

POISONING BY OPIUM OF A SUCKLING BABE THROUGH ITS MOTHER.—The *Boston Medical and Surgical Journal* says, "In our foreign exchanges we learn of a case of poisoning of an infant by opium administered to the mother. The latter was about to undergo an operation, and at ten o'clock in the morning she took twenty-five drops of Battley's sedative solution, and repeated the dose at two o'clock. At eight o'clock in the evening she took five centigrammes of opium in a pill.

"Her child, a strong boy seven weeks old, was restless throughout the day. At midnight he took the breast, and suddenly fell into a deep sleep, in which he remained for six hours. On awaking he sucked a little, and again slept throughout the day. At two P.M. respiration diminished in frequency, and became less deep and jerking. At six P.M. the pupil was contracted, respiration imperfect, jerking irregular, but in frequency nearly normal. It was with great difficulty that he could be aroused. Coffee was administered by the mouth and by the rectum, and the patient was exposed to the draught from an open window, and in about an hour he seemed better. An hour later, respiration ceased for a while, and he appeared dead; life, however, returned, and the following day, by two A.M., he was out of danger."

ALCOHOLIC SOLUTION OF BROMINE IN UTERINE CANCER.—Henneberg (*Centralblatt für die Med. Wis.*) reports six more cases in which the alcoholic solution of bromine (1.5) was proved to be of undoubted value, both in the after-treatment of the wounded surfaces after the enucleation of the cancer and in its direct application in the form of parenchymatous injections and tampons. Henneberg has further tested the action of bromine on cancerous neoplasms in various extirpated tumors. Portions of the tumor which were placed in the solution and left to remain in it for forty-eight hours, on being removed showed only fibres of connective tissue with isolated (*Spiegel*) mirror-cells. In the case of a freshly extirpated cervical cancer, the cancerous masses were found destroyed throughout.—*Med.-Chir. Centralblatt*, No. 18, 1875; *New York Medical Journal*.

REMOVAL OF BREAST BY ELASTIC LIGATURE.—M. Fériér presented to the Société de Chirurgie a cysto-sarcoma of the breast which he had removed from a female eighty-four years of age, who was in a very



# PHILADELPHIA MEDICAL TIMES.

A WEEKLY JOURNAL OF

MEDICAL AND SURGICAL SCIENCE.

*The Philadelphia Medical Times is an independent journal, devoted to no ends or interests whatever but those common to all who cultivate the science of medicine. Its columns are open to all those who wish to express their views on any subject coming within its legitimate sphere.*

*We invite contributions, reports of cases, notes and queries, medical news, and whatever may tend to increase the value of our pages.*

*All communications must bear the name of the sender (whether the name is to be published or not), and should be addressed to Editor Philadelphia Medical Times, care of the Publishers.*

PUBLISHED EVERY SATURDAY BY

J. B. LIPPINCOTT &amp; CO.,

715 and 717 Market St., Philadelphia, and 25 Bond St., New York.

SATURDAY, AUGUST 28, 1875.

## EDITORIAL.

### UTOPIA.

THERE can be no doubt at the present day that all individuals are not equally responsible for their offences against law or morality. Hereditary predisposition, the presence or absence of the "criminal neurosis," the influence of education and surroundings, are all powerful factors in the production or prevention of crime; and the time will come, we hope, when the circumstances determining these conditions shall have been so carefully studied and recorded as to permit of a natural and rational classification of criminals into various divisions, ranging from the thoroughly responsible to the totally irresponsible and insane. When this is done accurately and scientifically, when it shall be possible to distinguish with but little risk of error between the poor wretch who is blindly impelled to his deeds of lawlessness and outrage by an influence generated, perhaps, before he was conceived, and the cold-blooded, methodical villain, who, knowing the right, deliberately seeks the wrong, it will also be possible to apportion to each his proper meed of punishment, and restrain, confine, or execute with some regard to the relation which should obtain between the punitive measure and its object.

We can look forward then to the recognition by legislators of the fact that "moral and physical disease may have a common origin, and consequently

criminals "as much manufactured articles as are steam-engines and calico-printing machines." We can then hope to have framed not only retributive but also prophylactic and curative laws, and to see the medical expert a recognized authority in every tribunal of justice and a guide and counsellor in its judgments. We shall understand or abolish such apparent discrepancies as on the one hand the conviction and execution of a mere child for causeless and objectless murder, and on the other the exoneration on the ground of "insanity" of the "spiritual adviser" of a pious congregation from the undenied charges of indecent assault and attempt to commit rape. We shall know why lawyers, when they sin, peculate, why clergymen, of late years, fall victims to the temptations of the flesh,\* and why physicians—never wander from the path of rectitude.

While waiting, however, for the accumulation and development of this knowledge, if we are evolutionists we can solace ourselves with the Spencerian belief that whereas "man's primitive circumstances required that he should sacrifice the welfare of other beings to his own, his present circumstances require that he should not do so." His powers of restraint and self-control, like his other faculties, increasing with use, it follows that "progressive morality is a necessary consequence of the evolution of life," and that, if no mental or moral cataclysm occur, time alone will bring about a condition of perfection.

"Roll swiftly round, ye wheels of Time,  
And bring the blessed day."

## LEADING ARTICLES.

### THE INFLUENCE OF THE LOWER ORGANISMS IN THE PRODUCTION OF INFECTIOUS AND CONTAGIOUS DISEASES.

I.

MODERN, and especially recent, researches into the connection between infection and contagion, on the one hand, and the development of microscopic organisms, on the other, possess the deepest interest, not only for the pathologist but also for the practical physician. It is only by examination into the cause of disease-action that rational methods of prevention and cure can be fairly hoped for; and, although the work of the post-mortem room and the laboratory may seem to have but a remote bearing upon the clinical study of disease in many cases, yet it is by this in great measure that the physician of the future is to win his greatest triumphs.

\* "When it was asked Ovid why Ægyptus became an adulterer, he made no answer but this: 'Because he was idle.'"—RABELAIS.



Accepting this view, it is not necessary to apologize for offering in the pages of a journal intended for the practical physician a review of recent progress in our knowledge of certain points connected with the etiology of the infectious and contagious diseases.

Before presenting the analysis of these investigations which it is proposed to give, it seems advisable to allude to the subject of contagion and infection in general, and also to give some account of the organisms themselves which are now so generally believed to play a part in the production of the zymotic affections.

Two hypotheses in relation to the origin of the infectious and contagious diseases may be regarded as at present dominant, to the exclusion of all others. The first of these regards the poisons of infectious diseases as *chemical processes*. "A burning shaving," says Liebermeister, in elucidating this subject,\* "can set fire to a house and an entire city. The chemical process of burning multiplies itself ad infinitum, so long as combustible material and oxygen are present under favoring circumstances."

The second hypothesis ascribes the disease-process to the *multiplication of living organisms*.

Among chemical actions it is chiefly the processes of fermentation and decomposition which, by their capacity for extension by means of the smallest quantity of matter, show the most striking analogy to the contagious diseases. The name "zymotic" diseases (from ζυμωίν, to ferment), so generally adopted some years ago for this class of affections, shows the notion prevalent of their nature. "But the only ferment processes which can be taken into consideration are all associated with the presence and multiplication of low organisms. Accordingly, the existence of disease-poisons which have the capacity for infinite extension necessarily gives rise to the theory of a *contagium vivum*, and the conclusion can only escape those who satisfy themselves with the simple facts, and do not care to build up any theoretical idea on the origin of the diseases in question" (Liebermeister, *loc. cit.*).

It is certainly a fact that the hypothesis of living organisms as the origin of infectious disease has a high degree of plausibility to begin with, and though the evidence in its favor may be as yet comparatively meagre, conflicting in some details, and in many respects contradictory, yet it is constantly increasing by the labors of a host of conscientious and able workers; and the hypothesis itself bids fair to explain much in the action of disease which has hitherto been wrapped in obscurity.

The organisms to which are attributed the causation of disease belong to the lowest class of the vegetable kingdom. So minute are they, so little do they offer in the way of organization, and such formidable difficulties attend their investigation, that it is not surprising that their very nature, whether animal or vegetable, should long have been a matter of dispute.

Even at present, the whole subject of these lower organisms is beset with difficulties; not only their mode of action, but even their botanical nature and classification, continues to be the subject of active controversy.

Want of space, and the desire to avoid clogging with confusing detail an article intended rather for the general medical reader than for the specialist, prevent us going deeply into the subject of the classification and arrangement of the various organisms believed to be concerned in the origin and propagation of disease. Fortunately, we have at hand a very excellent article by Dr. L. A. Stimson, of New York,† from which we shall abstract such portions as seem necessary to elucidate our subject, and to which we can with pleasure refer any one desiring a clear and succinct *résumé* of the various names and classifications of the organisms under consideration which are at present in use, or which have been proposed.

The organisms of which we have been speaking are those commonly known under the general designation of bacteria or vibriones.

The terms *bacterium* and *vibrio* are well known, though their use is not infrequently coupled with a very imperfect idea of the organisms themselves. Briefly, it may be said that the term *bacteria* is, in France and Germany, ordinarily associated with microscopical bodies, round, oval, or rod-like, and jointed, found especially in putrefying vegetable and animal infusions. In England these organisms were formerly called vibriones, but this term is giving way to that of bacteria.

Used in a narrower sense, bacteria denotes stiff, rod-like bodies, single or jointed, motionless or endowed with an oscillating movement in place, while vibrio is applied to those that have an undulating, sinuous motion and move rapidly across the field of the microscope. These organisms are now almost universally believed to be of vegetable origin.

It would be impossible to give here an account of the various classifications proposed and adopted by different writers, but we shall endeavor to give some idea of those now most generally in use, in order that the terms used may be more intelligible. We extract from Dr. Stimson's article the classifications of Cohn and Billroth. Cohn, he says, makes the following divisions:

"BACTERIA.—Tribus I., *Sphaerobacteria* (Ball bacteria): Variety 1, Micrococcus.

"Tribus II., *Microbacteria* (Rod bacteria): Variety 2, Bacterium, subdivided into B. termo and B. lineola.

"Tribus III., *Desmobacteria* (Thread bacteria): Variety 3, Bacillus; Variety 4, Vibrio.

"Tribus IV., *Spirobacteria* (Spiral bacteria): Variety 5, Spirillum (of Ehrenberg); Variety 6, Spirochaete (of Ehrenberg).

"Billroth makes no claim to a complete botanical classification. He deals principally with the forms which

\* Ziemssen's Cyclopaedia of the Practice of Medicine, Am. ed., vol. i. p. 10.

N.Y. Med. Jour. 75, Aug. 28, 1875.



are found in animal infusions, and in the body during disease or after death. But, while he does not attempt to describe all the varieties, he gives a complete history of those which he has observed, tracing the whole cycle of their development, and showing so close a genetic relationship between them that it seems probable future investigation will show the others to be included in it. He considers all the forms combinations of spherical and cylindrical bodies, representing only different periods of development. His nomenclature and classification being based upon this opinion, he groups all under the name *coccobacteria* (κόκκος, a berry, and βακτηρία, a little rod), and gives to the different forms names which are compounds of these two with words denoting the number, size, and arrangement of the component parts; micro-, meso-, and mega-, signifying small, medium, and large; mono- and diplo-, single and double; strepto-, in chains; glia- (γλία, glue), in groups; asco-, in bags; and petalo-, in plates. This classification is simple and clear, for each name has the great advantage of describing accurately the form to which it is applied."

There are two terms met with constantly in recent pathological works which are not included here; these are *bacteridia* and *micrococcus* or *microzyma*. The former was applied by Davaine to long immovable forms of bacteria found by him in the blood of animals affected with anthrax; they belong in variety 3, bacillus of Cohn, while the latter is applied to the innumerable round or oval forms found in the tissues, secretions, or blood of persons suffering from septic diseases, and in putrefying liquids.

Bacteria are cells lacking chlorophyl, of spherical, oblong, or cylindrical form, which multiply by scission and vegetate either simply or in groups. Billroth and Cohn maintain that there is no genetic relationship between bacteria and any of the yeast-plants. Billroth, indeed, says that whenever any luxuriant yeast vegetation except *oidium lactis* is growing rapidly, the elements of *coccobacteria* do not flourish.

The germinative spores of bacteria, first described by Billroth under the name *dauersporen*, are glistening dark-bordered globules, which develop in their interior masses of *coccus*, which are set free by the bursting of the envelope, but are retained in contact with it sometimes by the presence of a mucous or gelatinous substance called *glia*. The *coccus* may multiply by lengthening and scission, or they may lengthen into bacteria, and gradually free themselves from the enveloping *glia* by their own active motions. This division or scission ordinarily occurs in one direction only (when it takes place at right angles also the well-known *sarcinia* forms are the result); the two pieces are held together by the *glia*, and each divides again and again. In this way rosary or chain-like forms result, the "streptococcus" of authors. The bacteria may often lengthen and divide transversely, forming the well-known jointed bacteria. All these developments, Dr. Stimson says, may be observed by any microscopist, and he has himself followed them frequently. The division or scission

may take place so rapidly that each bacterium forms a streptococcus, and the result is a gelatinous mass filled with *coccus*, and forming what is known as zoogloea. If the *glia* is very tenacious it may form a sort of membrane about the mass, known as ascococcus (ἀσκός, a bag), which sometimes shows amœboid movements. After a time this membrane bursts, the *coccus* escape, and the empty husk is found at the bottom of the vessel.

The final fate of bacteria may be either to leave the enclosing husk as finely granular sterile mucus, to break up rapidly into micrococcus within the husk, expanding it considerably, and forming a variety of ascococcus, or to contract into one or more glistening, dark-outlined bodies which are the germinative spores (*dauersporen*) above alluded to, and which, after a certain period of repose, may again germinate. The vitality of the latter is not destroyed by freezing, boiling-heat, or by drying, and these spores carried about in the air are undoubtedly the principal agents in the production of *coccobacteria*. Billroth had some which germinated after having been kept eight years. This is the only form which withstands drying; the *coccus* and bacteria do not.

The isolated *coccus* possess only a motion which cannot be distinguished from the ordinary molecular movement of very small, inert portions of matter, the so-called Brownian movement. When, however, they remain united in chains (streptococcus) they appear to have a sinuous serpent-like movement, which carries them sometimes with great rapidity across the field of the microscope. Progression is made in either direction, and the large spiral ones often move forward and backward across the field with almost the regularity of a pendulum. Occasionally one end remains attached to a larger object while the other vibrates slowly to and fro, or the whole revolves rapidly about its long axis without change of place. The larger microbacteria chains are usually motionless, and the isolated bacteria show only an oscillatory motion without change of place. The motions seem to be dependent upon the fluidity of the medium and the presence of oxygen.

For their nourishment bacteria need carbon, nitrogen, and certain of the elements of the ashes of ordinary yeast. Bacteria resemble green plants in this, that they assimilate the nitrogen contained in their cells in the form of ammonia compounds, which animals cannot do; on the other hand they differ from green plants and resemble animals in this, that they cannot take carbon from carbonic acid, but only from the organic compounds of carbon, especially the hydrocarbons and their derivatives.

Bacteria are not parasites; they do not live upon the materials intended for the nourishment of the tissues in which they are found, and cause the death of these tissues by starvation, but they probably live upon some of the elements of the substance itself, by the withdrawal of which new chemical combinations of the others are caused. Putrefaction is a correlative phenomenon of life, because it occurs only when a microscopical vege-

+Benton Sanders  
thinks from decomposition  
albumin substances only

Stop  
in Lectures



table organism nourishes itself and multiplies at the expense of a part of the putrescible substance. This organism is the bacterium, at least in some of its forms or varieties. Billroth believes its form known as *B. termo* to be the only one which excites putridity. Cohn says that they multiply as long as putridity lasts, and disappear so soon as it ceases. He is convinced that *B. termo* is the ferment of putrefaction, as yeast is the ferment of alcoholic fermentation, and that no putrefaction can begin without it or progress without its multiplication.

Bacteria exist in one form or another in all water, most animal tissues, and in the air. In the latter they are found only in the form of germinative spores, the other forms not being able to support the absence of moisture. Their presence in the healthy living body has been recently demonstrated beyond cavil by Billroth and Tiegel.

The spores which float in the air or are deposited upon exposed surfaces remain inert and innocuous until the conditions necessary to their development are supplied, among which moisture is the chief. It is generally agreed that these spores stand very low degrees of temperature (even 0° Fahr.) without losing their vitality. As regards the higher temperatures, observers differ, Cohn maintaining that a temperature of 140° Fahr. is sufficient to kill the spores, while Billroth, on the other hand, says they can stand 212° Fahr.

To recapitulate: Bacteria are microscopical vegetable organisms of two main varieties: 1. Round or oval cells 0.0005-0.0010 mm. in diameter, single or arranged in lines or groups (*sphærobacteria*, *micrococcus*, Cohn; *micrococcus*, *streptococcus*, Billroth). 2. Cylindrical cells 0.002-0.003 mm. long, single, or arranged in lines (*bacteria* of both authors). There is no genetic relationship between them and ordinary mould or fungus. They are found in the air, water, and most animal and vegetable tissues. They are saprophytes,\* not parasites, and are unable in themselves to cause any of the infectious diseases.

Having thus briefly sketched the current theories of contagion and infection, and having endeavored to give such an account of the organisms believed to be connected with disease-processes as to convey an intelligible idea of their general nature, we are prepared to examine the results of investigation as regards the influence of these organisms upon the production of the various infectious and contagious diseases. This examination, however, must be postponed to a future number of this journal.

**SYPHILIS** (*Archives of Dermatology*, July, 1875).—Stefanini reports the case of a young girl, who, having severe ulceration of the throat and velum, and iridocyclitis, which were unsuccessfully treated by the usual means, was rapidly cured by the injection of half a grain of calomel suspended in glycerin. Though no history of syphilis was obtainable, the author thinks the results of treatment warrant the diagnosis of that disease.

\* Saprophyte, *σάπρως*, putrid, and *φύρον*, plant.

## CORRESPONDENCE.

WASHINGTON, August, 1875.

TO THE EDITOR OF THE PHILADELPHIA MEDICAL TIMES:

SOME two years ago a prominent druggist of this city called my attention to the "Damiana" plant, claiming for it powerful aphrodisiacal properties. From his testimony and other certified evidence, I was tempted to give it a trial in that class of diseases generally termed "female weakness." My experience in these cases was quite satisfactory. In my hands it seemed to possess decided tonic properties, and when administered in combination with some of the ferruginous compounds, either the iodide or citrate, —giving of the "damiana" ʒij at a dose,—its beneficial effects were speedy and decided. With regard to its aphrodisiac virtues, my experience is as follows:

*Case I.*—In the early part of May last I was applied to by a negro woman aged 24, married four years. Three years before, she had been troubled with some uterine difficulty, the result of which was entire suppression of the menses; never had seen anything since. Her belief was that she had been "conjured" by some influence. She had never been pregnant, which was a source of unhappiness to both herself and husband. Her general health was good, save a slight leucorrhœa and pain periodically in the top of the head. I prescribed a general tonic and the "damiana" in ʒiij doses three times a day. Three months later her husband called at my office (they lived some forty miles in the country) to report progress; said his wife had "done had her sickness twice, and got all the 'signs' of being in that way," and her leucorrhœa had also disappeared.

*Case II.*—A young man aged 32 had lost his virility through excess and dissipation; all sexual desire entirely wanting; had been in that condition for some eight months. Came to me for treatment about the 12th of June last. I gave the ext. (fld.) damiana in ʒij doses three times a day; in about two weeks he reported decided improvement; continued treatment for about two months, and then he reported his manly functions entirely restored.

E. A. DUNCAN, M.D.

## PROCEEDINGS OF SOCIETIES.

### COLLEGE OF PHYSICIANS OF PHILADELPHIA.

JUNE 2, 1875.

*Case of encysted dropsy of the peritoneum, in which suppuration had occurred and abdominal section was performed, with recovery.*

DR. J. EWING MEARS read a paper describing the case of a lady, æt. 40, who had had six children, the youngest being 7 years of age. She dated the beginning of her illness from the last confinement, in which she was informed that the placenta was adherent, and she suffered severely from post-partum hemorrhage.

About three months after confinement, she noticed a small swelling in the right inguinal region; it was



PHILADELPHIA  
MEDICAL TIMES.

A WEEKLY JOURNAL OF

MEDICAL AND SURGICAL SCIENCE.

*The Philadelphia Medical Times is an independent journal, devoted to no ends or interests whatever but those common to all who cultivate the science of medicine. Its columns are open to all those who wish to express their views on any subject coming within its legitimate sphere.*

*We invite contributions, reports of cases, notes and queries, medical news, and whatever may tend to increase the value of our pages.*

*All communications must bear the name of the sender (whether the name is to be published or not), and should be addressed to Editor Philadelphia Medical Times, care of the Publishers.*

PUBLISHED EVERY SATURDAY BY

J. B. LIPPINCOTT & CO.,

715 and 717 Market St., Philadelphia, and 25 Bond St., New York.

SATURDAY, SEPTEMBER 4, 1875.

EDITORIAL.

A NEW HAPPY FAMILY.

THE establishment of a homœopathic hospital in New York has given a good-natured contemporary the opportunity of congratulating thereupon the followers of Hahnemann, the practitioners of opposing schools of medicine, and the public at large, and, like Mark Tapley, of "coming out strong" under rather unfavorable circumstances. It bases its cheerfulness in the matter upon the doctrine of the survival of the fittest, holding that if homœopathy is what we believe it to be, it will certainly be annihilated in the professional struggle for existence, and all the sooner for being brought into greater prominence and more active competition. We heartily coincide with these views, which are doubtless correct; but when it also looks forward hopefully to the appointment in connection with the same institution of a sort of supervisory or consulting board, to be composed of regular practitioners, who are to make the diagnoses, and, when the issue happens to be a disastrous one, are to verify them by "autopsical examination," we cannot share its sanguine anticipations. The adoption of the proposed plan would leave our homœopathic brethren sandwiched, as it were, between two layers of what they would term "allopathy," with merely the privilege of administering their attenuations and observing their effects or the absence of them; while, on the other hand, the consultant or diagnostician would frequently have to stand aloof and witness what would be, according to his views, the

needless sacrifice of human life, with the unpleasant feeling of being morally, if not legally, *particeps criminis*. We can imagine one of our venerable professors, a believer in counter-irritation, revulsion, and venesection, having, for example, made a diagnosis of congestive hyperæmia of the brain, threatening apoplexy, in a plethoric subject, modestly retiring into the background while his infinitesimal brother steps forward, consults his list of symptoms, and administers the hundred-thousandth dilution or trituration of what he conceives to be the appropriate remedy, after which, according to the "contemplated" programme, the patient would probably pass again into the hands of the "old school."

It seems somewhat unjust to exclude the other medical sects from the benefits of this new co-operative association, and we would suggest resigning the "autopsical" department to the Thomsonians, allowing the eclectics to sign the death-certificates, and requesting the "medical electricians," "cancer-doctors," and "herbalists" to attend the funerals in a body. The female doctors would have to be assigned to some department of importance and responsibility, or the managers would be overwhelmed with petitions and memorials. The "practical physicians," the "healing mediums," the "seventh sons of seventh sons," the "pow-wows," *et id genus omne*, whose services could probably be secured, and with equal propriety and judgment, would still remain to be provided for. Then would come to pass the saying which is written, "The wolf also shall dwell with the lamb, and the leopard shall lie down with the kid; and the calf and the young lion and the fatling together."

It must be understood, however, that the first-mentioned scheme of a board to make diagnoses and autopsies is not merely visionary or hypothetical, for we are told that "a plan having such an end in view is already under contemplation by the Commissioners of Charities and Correction," who, we believe, will be the managers of the new hospital.

We fear the commissioners will have to "contemplate" for an indefinite period before they find, even among the homœopaths, the necessary ignorance and imbecility upon which to base such an arrangement, and we feel sure they would encounter a still greater difficulty in persuading reputable physicians or surgeons to serve upon the diagnostic and "autopsical" board.

Seriously, although we do not view the acquisition of this new institution by the homœopaths as of any importance to the medical or scientific world, and believe it to be predestined to the obscure fate



of its predecessors in other cities, yet there is one aspect in which the matter assumes a gloomy significance. When we remember the intellectual status of the men to whose care, under its auspices, human lives will be confided, and when we recall the list recently published in one of our daily papers, of cases neglected and maltreated at a similar institution in this city, we cannot but feel that the experiment is almost too costly.

We can see no more reason why a homœopathic practitioner should be allowed the opportunity of demonstrating his lack of common sense at the cost of suffering humanity than why any of those more generally recognized as quacks should be allowed the same privilege; and our contemporary's suggestion that we should "combat error on the common ground of reason and the broad platform of enlightened liberality" applies with equal force to all who practise by an exclusive dogma.

## LEADING ARTICLES.

### THE INFLUENCE OF THE LOWER ORGANISMS IN THE PRODUCTION OF INFECTIOUS AND CONTAGIOUS DISEASES.

#### II.

HAVING in the earlier portion of this article given some account of bacteria in general, it now remains to follow up, so far as possible, the progress of investigation as regards the influence of these organisms on disease, and to examine the present state of our knowledge concerning this influence.

In doing this we shall take up in the first place the subjects of pyæmia and septicæmia, since it was in regard to the occurrence of the lower organisms in these conditions that the earlier investigations of their action were made.

The frequency and gravity of septic complications of wounds have made their etiology, pathology, and treatment one of the most important and interesting of all surgical problems, and the scanty success which has thus far attended all prophylactic and remedial measures shows that the problem in part, at least, is still unsolved.

The intimate connection between putrefactive processes and the group of symptoms called septicæmia has been regarded as established since the celebrated experiments of Gaspard.\* Their cause was at first supposed to lie in the absorption of the pus of the wound through the open mouths of the several vessels; then in poisoning of the blood by pus formed in the interior of the vessels by phlebitis. Piorry about 1835 gave a full and accurate account of those symptoms to which he afterwards gave the name septicæmia, by which they have

since been known. He ascribed the disease solely to the effects of the absorption of putrid matter through the lungs, skin, intestine, or the surface of a wound, but did not attempt to discover the source of its virulence.

Panum, in 1856, spoke of a non-volatile septic poison which is insoluble in absolute alcohol, soluble in water, and not destroyed by prolonged boiling. Robin considered the virulence due to a catalytic effect produced upon the humors and tissues of the body by contact with a substance in which putrefaction had brought about an isomeric change in the fundamental "immediate principle." He said, "Putridity is not virulence; on the contrary, when it has advanced to a certain degree it destroys virulence;" a statement now universally accepted. Bergman also took the same view, believing the toxic action of putrid substances to be due, not to inferior organisms, but to a diffusible nitrogenized toxic substance resisting alcohol, ether, and boiling heat, and formed during putrefaction.

While thus certain investigators examined the causes of pyæmia and septicæmia from this point of view, others were not wanting who continued to maintain the bacterial origin of disease, and their views were supported by very numerous and varied experiments, to some of which allusion will now be made.

Mayrhofer (1863) claimed that puerperal fever was due to low organisms, which he called vibriones. He observed that they appear in the lochia of healthy lying-in women in small quantities on the fifth day after delivery, but in those attacked by puerperal fever, immediately after delivery, and in large quantities. Injecting a putrid infusion of meat into the uterus of a rabbit soon after delivery, its death resulted from endometritis with septicæmic symptoms.

Leplat and Jallard made inoculations with putrefying animal and vegetable infusions containing vibriones without causing septicæmic results. They hence concluded that vibriones coming from putrefying animal and vegetable substances cause no accidents when injected unless accompanied by virulent agents, which latter are alone responsible for any unfortunate results that may ensue.

The experiments of Coze and Feltz (1865), they asserted, proved that the blood of animals inoculated with putrefying fluids is itself infectious, that it contains bacteria, and that the infectious ferment gains in force by its passage through the organism. They claimed also that the organisms found in the blood are the active efficient agents in the poisoning, and they agreed with Pasteur in saying that there are two phases of putrefaction, of which only the first would cause poisonous symptoms. Hence putrefaction destroys virulence.

In 1869-72, Davaine, investigating anthrax (malignant pustule), discovered bacteridia in the blood of patients. In a report upon inoculations with putrid blood, Davaine confirmed the experience of Coze and Feltz in regard to the gain of virulence by repeated transmissions, and also the destruction of the septicæmic virus by putrefaction. Davaine's experiments received much attention, and at first his conclusions were distrusted;

\* Jour. de Phys., par Magendie. T. i. p. 1, 1822, and T. iv. p. 1, 1824.



but, having been substantially confirmed by other investigators, the following points were generally conceded. 1. Susceptibility to the virus varies in different animals. 2. Putrid blood loses its virulence as it gets older. 3. Septicæmia is a putrefaction taking place in the blood of an animal, and induced by bacteria and vibriones. 4. Blood putrefied within the body is much less poisonous than that of an individual whose death has been caused by or who is still suffering from septicæmia, typhoid fever, or gangrene of the lung. 5. The one-millionth part of a drop of such blood injected into the cellular tissue of a rabbit will cause the death of the animal within twenty-four hours. 6. The poisonous quality of the blood is entirely due to the presence of bacteria.

Vulpian and Onimus contended against these conclusions; and subsequent experiments, especially those made by Billroth,\* which excited universal attention, have tended to diminish the importance claimed for bacteria.

Billroth's experiments, which were chiefly clinical, were most thorough and extensive. He found in two hundred autopsies, of all diseases, coccobacteria present in eighty-seven in the pericardial liquid. The longer the interval between the time of death and the examination, and the higher the temperature of the air, the more certainly were these organisms found. Although they are found in abundance during life on many of the mucous membranes, it is probable that they make their way into the tissues and circulation only through the lungs, and that they remain, especially in the blood, in the form of germs capable of development.

Experiments made by Lewis and Cunningham, Calcutta, in 1874, upon dogs, showed large quantities of bacteria after the injection, not of a putrefying organic liquid, but of ammonia, into the peritoneal cavity.

We have thus endeavored to give some idea of the progress of investigation in this direction, but, of course, have been obliged to omit even the mention of numerous highly meritorious communications or monographs. The very recent literature of the subject is voluminous. Birch-Hirschfeld,† to whom we are very considerably indebted for the facts and discussions of the present part of our article, cites no fewer than eighty-six recent contributions, most of which have been published within the last two years; and one-half of these give the results of experiments upon pyæmia and septicæmia.

And yet, what exactly do we understand by these terms? In regard to this, Birch-Hirschfeld speaks nearly as follows:

"The names septicæmia and pyæmia are, by many authors, used almost as if synonymous, whilst others regard these affections as perfectly distinct. When, however, the exact line of division between them has to be defined, there is very little agreement. It is

certainly true, as Virchow has demonstrated, that the morphological introduction of pus into the circulation does not result in pyæmia, yet this affection is beyond doubt closely connected with suppuration. It must then be distinctly separated from the septicæmia caused by putrid matter alone, and entirely unconnected with pus. Now, if it can be shown that in pyæmia dependent upon suppuration the putrefaction of pus gave rise to the infection, it would certainly appear as if pyæmia itself were only a species of septicæmia.

"Another view, and one widely diffused, lays stress upon the occurrence of symptoms of embolic metastasis as a distinguishing point. When traumatic infection results fatally without the occurrence of metastatic emboli, the affection is termed septicæmia; under the contrary circumstances, pyæmia. This distinction will hardly, however, suit all cases."

We must confess that an examination of Birch-Hirschfeld's abstract of the various contributions to our knowledge of the influence of bacteria on pyæmia and septicæmia is at first not inspiring.

The forty-odd investigators reach nearly as many conclusions, and we must admit, as does Birch-Hirschfeld himself, that their position on these points is certainly very contradictory. Indeed, there are very few assertions made which, after a careful review of all the authorities, are found entirely undisputed. If, at first sight, this position of affairs seems to the seeker after truth somewhat depressing, yet we must remember that much of this work is good work and genuine. It is work of research, and not mere speculation. We hold no axiom to be more eternally true than this: that good work always pays. These facts, which now seem so scattered, so contradictory, so impossible of assimilation, will one day be found parts of a plan which, as yet, we are unable to comprehend.

The hope must indeed be regarded as illusive, that in this department the object of research is to be attained without great difficulty. The processes concerned are of such a complex nature, and our methods in many respects so inadequate, that it is hardly to be expected we shall reach at this time\* results which shall be entirely unquestioned.

We cannot conclude this portion of our subject better than by quoting the opinion of one of the very greatest of living pathologists, Virchow.‡

Although these remarks of Virchow particularly relate to Billroth's work already alluded to, yet they are equally applicable in many respects to the subject in general. Virchow says, "Without venturing an opinion as regards the correctness of the botanical section of this admirable work [Billroth's "Coccobacteria Septica"], I must confess that it agrees only in part with my own preconceived ideas upon the subject. I certainly hold as correct the idea that the ordinary putrefactive germs are sufficient to explain a greater part of the local, as well as a certain portion of the

\* Coccobacteria Septica, etc. Berlin, 1874.

† Die neueren pathologisch-anatomischen Untersuchungen über Vorkommen und Bedeutung niederer Pilzformen (Bakterien) bei Infektionskrankheiten. Schmidt's Jahrbücher, 1875, No. 5, p. 169.

‡ Vortrag über die Fortschritte der Kriegsheilkunde, etc., besonders im Gebiete der Infektionskrankheiten. Berlin, 1874. Reprint from Allg. milit.-ärztl. Ztg., 36, 41, 1874.



general, infectious diseases. This is that province which we have always conceded, of which the highest development is septicæmia.

"The greater number of diphtheritic processes are comprised under this head, in regard to the affinity of which with putridity we have spoken long since. Their relationship is certainly closer than has been previously admitted,—indeed, closer than even Billroth is as yet inclined to admit."

Further, Virchow maintains, if pathological significance be attributed to parasitic plants, the identity of the various forms of miasma must be conceded, and it must also be admitted that this same miasma gives rise, according to the surroundings, to typhoid fever, dysentery, diphtheritis, hospital gangrene, or septicæmia. If, with Billroth, we look upon all these parasitic plants as mere vegetation-forms of coccobacteria septica, cholera may also be included here.

Only two explanations appear possible in this direction. Either the micro-organisms of all these disease-processes are identical, and it is necessary to assume poisonous substances in connection with the fungi and algæ yet distinct from these; or the micro-organisms are, *in spite of apparent similarities, different*, and form the carriers and excitors of the most serious processes in the body; they are in fact the peculiar causes of disease.

The rôle of the micro-organisms may again, under the latter view, be understood variously. Either these objects attack the living portions of the body directly, or they bring with them a poison which threatens life. This poison may either exist in the micro-organisms themselves, and they consequently be regarded as poisonous plants, or the putrefactive organisms are related to the putrid poison as the yeast-plant is to fermenting substances: they are ferments.

For the great infectious diseases, Virchow is inclined to the last-mentioned hypothesis. These distinct poisons are separable from the micro-organisms which have excited them.

It may easily be believed, therefore, that a mass of fungi (pilzheerde) may collect at a point of inoculation or of wounding in the human body, which may secrete poison the amount of which might be sufficient to put the whole body in jeopardy, without the fungus itself being taken up by the blood.

According to Panum's researches, septicæmia cannot be referred to *mechanical* disturbance by means of micro-organisms. It does not follow upon this, however, that the excitation of putrefactive poisoning is possible without the presence of putrefactive germs. *On the contrary, the more we investigate, the more evident it appears that it is indeed the organisms themselves which cause the mischief.*

In putrefactive processes the micro-organisms may easily be identified, and their influence upon the progress of decomposition may be conveniently observed. The difficulty of understanding the pathological significance of these processes would only be insuperable *if in fact a single plant* produced the various

forms of putrefactive organisms. Here, however, practical research in regard to the physiological and pathological action of the disease-germs is decidedly in opposition to morphological research.

If these form-elements cause different effects, they themselves must be essentially different. We cannot, it is true, directly see these essential (innate) differences in such minute organisms; but we must remember that neither can we tell, from the germinative cells of the egg, numerous pathological growths, etc., what may come out of these. If it happens by inoculation that through bacteria which resemble those of the usual putrid infusions malignant pustule arises, while the bacteria of the usual putrid infusions do not cause this, then we must conclude that the bacteria of malignant pustule must be at least as different from those of infusions as hemlock from parsley.

So much for the influence of bacteria in the production of pyæmia and septicæmia. In the third and concluding portion of this article we shall examine the present state of knowledge respecting the production of other affections by the agency of the lower organisms.

## CORRESPONDENCE.

NEW YORK, August 20, 1875.

TO THE EDITOR OF THE PHILADELPHIA MEDICAL TIMES:

DR. ERSKINE MASON, who has been especially interested in the subject of intestinal obstruction, and has performed a number of operations for its relief, recently operated in a case of carcinoma of the rectum. The fæces passed had been gradually becoming more and more attenuated, until they ceased altogether to come away, the bowel being entirely occluded. The lower portion of the cancerous mass could be felt by the finger about one and a half inches within the anus. A number of well-known surgeons were present at the operation, which was performed at Roosevelt Hospital, where Dr. Mason is one of the attending surgeons, and which was that of lumbar colotomy, for the purpose of establishing an artificial anus. The patient rallied well after it, and the procedure will, no doubt, prolong her life for some time; though the disease is steadily advancing, and has now involved the uterus to some extent.

Just at the conclusion of the operation, Prof. Alonzo Clark walked into the amphitheatre, and was politely asked by Dr. Mason if he would not like to make a digital examination of the diseased parts. The old gentleman, looking around complacently on the others present, some of whom were still lugubriously sniffing their fore-fingers, from which soap and water had been quite ineffectual in removing the disgusting odor, replied, in the driest possible manner, "No, I thank you, doctor; I am quite willing to take the word of my friends here."

The third annual report of the visiting committee for Bellevue and other public hospitals of New York to the



adding, in displayed type, Dr. —, aurist, or what may be, in charge, office such and such street, hours such and such. Then all goes merry as a marriage-bell; the dear public learn where their special ills may be cured, practice flows in, professional etiquette is maintained, and universal harmony prevails.

URINALS.—Whether, by locating proper urinals, our city authorities will ever do away with the hideous sign-boards “Commit no Nuisance here,” as well as with the stained walls of alley-ways and the streamlets which trickle often most inopportunistly in the evening across the pavements, we do not know. We live, however, in hope, and consequently note with interest that in London only such urinals are found to remain decent as are built of slate, with a wide, well-inclined gutter, and a free stream of water constantly running.

THE lowest point in the race towards complete degradation appears to have been reached by the Keokuk Medical College. According to the *Clinic*, its catalogue is illustrated with a “hideous dissecting-room scene.” The pictures displaying perineal dissection are said to be “disgusting in the extreme.” *O tempora! O mores!*

OUR readers will remember our notice of the case of Dr. Wood, who was put on trial in England for manslaughter, on account of the death of a woman under his care from rupture of the uterus during labor. We are happy to say that, by direction of the judge, he has been acquitted.

THE London *Lancet* warns against the deleterious effects of travel in the underground railways of the metropolis, on account of the excessive impurity of the confined air of the tunnels.

THE Philadelphia colleges have already commenced their autumnal courses, and the indications of large classes this winter are very good.

### LEADING ARTICLES.

#### THE INFLUENCE OF THE LOWER ORGANISMS IN THE PRODUCTION OF INFECTIOUS AND CONTAGIOUS DISEASES.

##### III.

IN addition to the diseases which are connected with the putrefactive process or with local inflammations, bacteria have been found in all fevers, the contagious characters of which have been by some attributed to these organisms.

So far back as 1850, Panum expressed the idea that the development of a certain kind of fungus stood in a specific relation to cholera. More recently Coze and Feltz have maintained fevers to be, in fact, internal fermentations, depending upon organisms in the blood. Hallier regards them as internal parasitic diseases, and attempts to describe the various forms of fungi observed in each. Buhl, Waldeyer, and Wagner describe a disease under the name of *intestinal mycosis*, which they suppose to be intimately connected with malignant pustule, and which proves most rapidly fatal with choleraic symptoms.

As regards the bacteritic origin of malignant pustule itself, reference has already been made to this point. Bollinger thinks, with the authors just mentioned, that the so-called intestinal mycosis is only a form of malignant pustule. Christot and Kiener found bacteria in the blood of a man who died of glanders, and also in the blood of various inoculated animals. Although Obermeier does not attempt to decide whether the moving filaments he describes as occurring in recurrent fever are specific or even at all pathological, the discovery of their constant presence in this disease must be most interesting as bearing upon the present question of animated pathology. The various substances found by Salisbury in the excreta of different diseases seem unlike anything met with by other observers.

Bacteria, as we see them, are described as occurring in a large number of diseases of the most varied nature, differing not only very widely in their clinical history, but which have also for many centuries held places in very separate categories. How far may each of these diseases, so radically distinct in their natures, be attributed to a specific organism peculiar to itself? Hallier endeavored to answer this question by describing a distinct form of fungus for each fever; his ideas, however, have long since been abandoned. Few other attempts have been made to draw any distinctions between the forms of fungi found in different diseases.

Letzerich has recently described a form of fungus which he finds in the mucus, and even air-vesicles, in whooping-cough. This he considers the specific cause of the disease, and believes himself able to produce true whooping-cough in the rabbit by means of the fungi removed from patients suffering with this disease and cultivated in a solution of sugar! He also describes differences between the diphtheritic fungi and those found in whooping-cough, in their mode of development, appearance, and action: the fungus of the latter disease does not penetrate the tissues or tend to produce putrefaction, both of which characters are found in the diphtheria bacteria. Klein has described some very peculiar organisms in the tissues around the lesion of typhoid fever, which seem unlike the micrococci usually met with and may be peculiar to that disease. Billroth says, and we believe this opinion is now shared by most adherents of the bacterial theory of disease, that though different modes of culture may produce various forms, according to the nutrient matter used, none differ in any essential point from those found in



putrid substances outside the body. From this fact, and from the similarity which exists between the forms described in various diseases, he concludes that, up to the present, no morphological distinction is known by which one can decide that a given bacterium belongs to any definite disease.\*

Besides the investigations into the bacterial origin of malignant pustule, glanders, recurrent and typhoid fevers, and whooping-cough, above mentioned, researches into the following affections have of late been undertaken from the same standpoint. Heiberg, Virchow, Eberth, Rud. Maier, Burkhart, Heiler, have all contributed studies or single cases of the so-called endocarditis bacterica, mycosis endocardii, or diphtheritic endocarditis. Researches upon the bacterial origin of erysipelas have been published by Anfrecht, Orth, Hirschberg, Hiller, and Lukomsky, the latter attracting very considerable attention. In regard to cholera, Lewis's and Cunningham's researches have been very careful and are worthy of study. Eberle, Nedswetzky, and Andreas Högyes have also published researches in the same direction. Variola as connected with the lower organisms has received attention from Lugenbühl, Zuelzer, and Weigert. Even acute yellow atrophy of the liver has been regarded by Klebs and Lander as connected with bacteria.

Recently a discussion took place in the London Pathological Society upon the germ-theory of disease, in which the whole subject was brought up for review. Dr. Charlton Bastian, a well-known advocate of the theory of spontaneous generation, opened the question in an able address combating the hypothesis of a bacterial origin of disease. The propositions maintained by him may be briefly summed up as follows:

1. With two exceptions, no definite germs or organisms are to be met with in the blood of patients suffering from these diseases in any stage of their progress.
2. The virus or contagium of some of these diseases, whatever it may be, does not exhibit the properties of living matter.
3. On the other hand, the virus of most of these contagious diseases with which definite experiment has been made is most potent in the fresh state, whilst its power very distinctly diminishes in intensity as organisms reveal their presence more abundantly therein,—facts which seem to point to the conclusion, or at least are quite consistent with the notion, that the contagious poison may be a chemical compound which gradually becomes destroyed or modified by the successive changes taking place in association with processes of putrefaction.
4. There is the extreme improbability of the supposition that this whole class of diseases should be caused by organisms known only by their effects.
5. The facts of the sudden cessation, periodical visitation, and many other phenomena of epidemics, however difficult they may be to explain upon any

hypothesis, seem to oppose almost insuperable obstacles to the belief that living organisms are the causes of such epidemics of specific contagious diseases.

Dr. Bastian's views were ably attacked by Dr. Burdon Sanderson, who pointed out the impossibility of reconciling the appearance and disappearance of the spirilla germs in the exacerbations and intervals of relapsing fever with any theory of contagion save the germ-theory. He also alluded to the course of sheep-pox, where two processes went on simultaneously, the development of pustules and the development of organisms. The debate was carried on by various other investigators, of less celebrity, but showed a tendency to theorizing without an adequate amount of facts, and, upon the whole, the discussion has not added very much to our knowledge of the subject.

Birch-Hirschfeld, in a general survey of the present state of our knowledge of the bacterial origin of disease, speaks as follows:

"We must confess that in a majority of diseases the fungous origin of which has been made the subject of inquiry, we possess little or no exact proof of a parasitic cause, not even in the case of malignant pustule or that of relapsing fever. But the *probability* that bacteria are not insignificant associates of these pathological processes is, to an unprejudiced observer of the facts recently discovered, very strong, and the same may be said of the diseases previously mentioned.

"The chief difficulty in the discrimination of the objects alluded to lies in their extremely small size, in the unsatisfactory condition of our knowledge regarding their development and the circumstances of their existence.

"The morphological similarity of the various species of bacteria found in connection with different diseases is certainly, as has been said before, no evidence against their pathological significance, but it undoubtedly is a great hindrance to their convincing demonstration.

"There can be no question, however, on the other hand, that much which we already know regarding various circumstances connected with the life and development of bacteria agrees singularly well with the ideas impressed upon our minds when we endeavor to form a conception of the infectious material of epidemic disease. We find ourselves under these circumstances almost inevitably forced to think and speak of the *germs* of infection, not the *gases* of infection, and so on. The usually unnoticed penetration within the body, the period of incubation (which we can scarcely explain otherwise than by the theory that the germs must first develop themselves in the body to a certain extent before they unfold their injurious action), the spread and increase of contagion from sick bodies,—all these facts point to such an explanation.

"Let it be considered, further, that only a portion and not all of the population are attacked in an epidemic of any given disease, although the infectious material undoubtedly reaches all or nearly all. This obliges us to admit that the observed facts are most easily ex-

\* We are indebted for this review of progress, as well as for various other materials used in this article, to a "Report on Pathological Anatomy," by Dr. Gerald Yeo, Irish Hospital Gazette, October 1, 1874.

\* Smallpox & vaccine virus ought, one would suppose, to have given demonstration on this subject, if obtainable.



cells of the mucous membrane of the intestine in cholera. In the contents of the blood-vessels of the same disease, and in the blood taken from the vessels almost immediately after death of animals destroyed by cattle-plague and other fevers, similar bodies have been found, though probably not of exactly the same kind in every case.

... Sometimes these germs grow and multiply in a secretion not perfectly healthy before it has left the gland-follicles, and they have been detected in the milk as it issued from the breast, in the saliva, in the bile and urine, as well as in other secretions. It will no doubt be said in all these cases, 'the germs have been introduced from without,—they pass from the air into the orifice of the duct, and thus make their way to the gland. From this point they might readily pass into the blood.' But it is more likely they are in the blood and in the tissues at all times. They are met with in the blood especially in some instances in which there is no reason whatever for concluding they made their way into this fluid shortly before they were found. Nay, little particles may be seen in the circulating fluid which I believe to be these lowly germs, ready to grow and multiply whenever the conditions become favorable. I have seen such particles adhering to the surface of the white blood-corpuscles, and also to the red blood-corpuscles."

Prof. H. C. Wood, Jr., of this city, another able opponent of the germ-theory of disease, in his excellent article "On the Production of General Diseases by Organic Entities," remarks, "Whether the views of Prof. Wyman [regarding putrefaction] be correct or not, it is certain that under ordinary circumstances vibrios, etc. are always the accompaniments of putrefaction, and may frequently be found in a fluid before it has undergone more manifest changes. In the *milzbrand* of domestic animals and its probable derivative in man, *malignant pustule*, these bodies have frequently been found in the blood, but are said not to be present in all cases, and when present to be of fatal significance. *A priori* reasoning suggests that their spores are of very necessity at all times present in the blood; and the experiments of Frau Lüders seem to establish this. That lady took a small glass tube with the ends hermetically closed, which had been exposed for half an hour to a temperature of 290° C., and thrust it into the heart of a recently-killed guinea-pig and then broke off the ends. After the blood had been sucked into the tube from the other end, which was melted off to remove any fluid that might adhere from the lips, the ends of the tube were sealed, and it was kept at a temperature of from 13° to 15° C. After two days, fungous granules, chains, and rods were abundant. If then the spores of the vibronidæ be always present in the blood, they must of very necessity develop themselves whenever that fluid is strongly disposed to putrefactive changes, as it is in malignant pustule." (See *American Journal of the Medical Sciences*, October, 1868, p. 349.)

That some of the minute particles constantly found in normal human blood and partly constituting the globulins of Donné, the molecular substance of Griffith and Henfy, the microzymes of Dr. Burdon Sanderson and sundry French authors, and the germinal matter of Beale,—at least in his earlier writings,—present the aspect of fungous spores, and develop into Bacteria-like bodies, is shown by the following experiment, which I have repeated a sufficient number of times to convince myself that I have not been misled by any false interpretations of the appearances presented.

A drop of blood from the finger, drawn with careful precautions against adulteration, was covered with a large thin glass in such a manner as to include a few bubbles of air, and the whole hermetically sealed by a layer of gold-size applied at the margin of the covering glass. A suitable field of view being selected, containing between the *rouleaux* of red corpuscles several large

open spaces, in which could be seen with a  $\frac{1}{2}$ -inch objective sundry of the tiny particles above referred to, each in active movement,—perhaps molecular in its character,—the slide was firmly secured in position, and careful observations and drawings were made at short intervals, except through the night, for three days, at the end of which period the minute granules first seen had developed to three times their original size, becoming about  $\frac{1}{1000}$  of an inch long, assuming an elongated dumb-bell shape, and increasing in number so that the place of a primary particle would often be occupied by six, eight, or ten Bacteria-like bodies, sometimes irregularly grouped together, but quite frequently assuming the branching arrangement so characteristic of the jointed mycelia of the lower vegetable organisms.

A series of my own experiments performed to demonstrate the presence, mode of entrance, and pathological effects of Bacteria in human blood, were detailed in the *American Journal of the Medical Sciences* for July, 1868, from which I extract the following as the most important:

"Experiment 4.—At 7.45 P.M., May 17, 1868, I drank four fluidounces of water similar to that employed in the preceding investigations, and containing multitudes of bacteria (estimated as numbering 27,000,000,000). At a quarter-past eight I examined a drop of blood drawn with a cataract-needle from the tip of my finger, and confined between a slide and cover cleaned with strong hydrochloric acid as above described. Under the field of the one-twenty-fifth-inch glass the interspaces between the rows of blood-corpuscles were found to contain multitudes of apparently spherical molecules, in rapid and erratic motion,—but so very minute as to readily escape notice even with this high power, except under the closest scrutiny; in the course of half an hour not less than one hundred were observed. At 9 P.M. another drop of blood, examined with the same precautions, exhibited, in addition to these minute particles, other bodies, less active in their movements, of much greater magnitude, and which under an amplification of eleven hundred diameters appeared precisely similar to the bacteria I had been studying a few hours before in the identical decomposing beef-juice imbibed.\* Five of them were thus enlarged sufficiently to exhibit an unmistakable organized structure totally different from their associated aggregations of Beale's germinal matter. Three of these bacteria were each about  $\frac{1}{12000}$  of an inch in length and  $\frac{1}{25000}$  of an inch in width, very distinctly constricted in the middle; a fourth was obviously composed of four, and a fifth of six joints arranged in a straight line, whose motion was of that peculiar waving character so universal among the Oscillatoriaceæ. The last two were most clearly visible when they happened to lie vertically to the surface of the glass, and would probably escape observation under the one-eighth-inch except in that position, or be therefore mistaken for simple globular bodies, although in several cases I detected in the second and third experiments (with a lower power) a shadowy elongation of one diameter on the revolving molecules thus observed."

These results which I obtained were not confirmed during a repetition of my experiments made partly under the supervision of Col. J. J. Woodward, of the Army Medical Museum at Washington, but which were not, as has been stated by him, uniformly without any effect; and although such evidence must of course be allowed to have for negative testimony unusual weight, it should, I think, be viewed in conjunction with the observations of Dr. Neffel, of New York City, and M. E. Semmer, of Dorpat, whose researches go far to confirm my conclusions.

Dr. Neffel remarks (see *Medical Record*, July 15, 1868, p. 226), "Finally, I may mention the experiments which I myself made last year in Prof. Virchow's Pathological Institute and Dr. Kühne's Chemical Laboratory, and which I still continue. My object was to study the

\*Careful and repeated observations had of course been made to establish the fact that similar particles were not visible in my blood immediately before drinking the bacteria.



influence and mode of action of cryptogams in the animal body. For this purpose I produced a fistula of the small intestines in dogs, and through it introduced the fungi. I also injected cryptogams into the respiratory organs of dogs and rabbits by means of tracheotomy; again I injected them hypodermically; into the veins; into the abdominal cavity; and at last I introduced them into the lymphatic sacs of frogs and observed by Cohnheim's method; and, after giving a detailed account of particular investigations, he observes, "My experiments so far lead me to the conclusion that the lower vegetable organisms can continue to live and multiply in the tissues of living animals, and that they can enter into the general circulation either through the intestinal canal or respiratory organs or by means of hypodermic injections. What is their ultimate fate in the animal organism, and what their importance in producing disease, further investigations will have to show."

In further corroboration of my researches I may quote the experiments of M. E. Semmer, Prosecutor to the Veterinary Institute of Dorpat, described in his paper on the "Results of Injection of Fungous Spores and Fungous Cells into the Blood of Animals." This gentleman states that whilst in the blood of creatures affected with glanders, splenic inflammation, and septicæmia, micrococcus cells, mycothrix- and leptothrix-chains and threads are common, the circulating fluid of healthy beasts contains generally a few similar cells, and analogous rods and chains are to be met with in the liver and intestine. He also details three series of experiments made to test the question whether these contagious diseases were caused by the fungi found in the blood, and fully narrates the post-mortem examination of a foal into whose jugular vein was injected about two ounces of distilled water containing countless fungus-spores and micrococcus-cells, cultivated from splenic disease (*milsbrand*) blood upon boiled material, the poisonous dose causing the death of the animal on the eleventh day, preceded by loss of appetite, tottering gait, and marked febrile action. (See *Virchow's Archiv*, fünfzigsten Band, erstes Heft, S. 159, Berlin, 16. April, 1870.)

Influenced, therefore, by the positive statements of Drs. Lionel S. Beale and H. C. Wood, Jr., and the direct observations of M. Davaine, Dr. Neffel, and M. E. Semmer, as well as by the results of my own personal investigations, I think we must admit that Bacteria not only live but flourish in the blood of animals and of man with more or less frequency during the course of various maladies; yet whether by so existing in the circulating fluid these vegetable organisms constitute causes of disease, or whether they are simply products, or, again, mere accidental accompaniments of morbid action, it appears to me we have not hitherto accumulated a sufficient number of facts to enable us to decide.

Hence I think the profession is as yet unprepared to accept the doctrine of Dr. A. E. Sansom in his late work, "The Antiseptic System," London, 1871, p. x., where he says, "From a review of all the facts and observations I have been led to enunciate the theory that the poisons of spreading diseases are extremely minute living organisms, having the characteristic endowments of vegetable growths analogous to the minute particles of vegetable protoplasm whose function it is to disintegrate and convert complex organic products, owing their specific properties in special diseases not to any botanical peculiarities, but to the characters implanted in them by the soil in which they first sprang from innocuous parents, and from which they are transmitted,—this soil, except in the case of their earliest origin, being the fluids of the animal body."

In order, however, that such researches as those above referred to may be made, even in their present incomplete state, to aid us in improving the science of medicine, permit me to suggest that each Bacterium existing

in the blood (whether as a poisonous cause, a product, or an accident of disease, I refrain from discussing at present) must during every moment of its life appropriate some minute portion of pabulum, which would otherwise have contributed to nourish the tissues of the animal in which it resides; and that therefore the sum total of the Bacterian influences (unless they feed solely upon effete matters, unlike their analogues of the dermatophytic affections) must be effective towards diminishing the vital power of the organism on whose life-blood they prey.

This view is confirmed by the experiments of Dr. Burdon Sanderson in his late interesting memoir "On the Origin and Distribution of Microzymes [Bacteria] in Water, and the Circumstances which determine their Existence in the Tissues and Liquids of the Living Body," in which he says, "As regards their [the Microzymes'] action on the liquids in which they live, the most important facts are (1) that their growth is attended with absorption of oxygen and discharge of carbonic acid; (2) that they are remarkably independent of the chemical constitution of the medium, provided that they are supplied with oxygen; and (3) that they take nitrogen from almost any source which contains it, and use it for building up their own protoplasm. It is this last power which specially indicates what may be called their place in nature, as the universal *destroyers* of nitrogenous substances, acting as the pioneers, if not the producers, of putrefaction. They exercise this function, not by virtue of any special relation of their own nutritive processes to putrefaction as such, but simply by their extraordinary power of seizing on the elements which they require for the construction of their own bodies." (See *Quarterly Journal of Microscopical Science*, October, 1871, p. 326.)

Upon this doctrine it is not difficult to find a theory for explaining the probable mode of operation of quinine and arsenic,—so long a problem in therapeutics,—when acting as tonics upon the human system in many cases of disease: namely, that in part, at least, they serve their important purpose by rendering the blood less fit for the development of these lower organisms, and in this way *economizing* the supply of nutritive material in the circulating fluid. Many well-known peculiarities in the action of these two principal tonic medicines tend to confirm such a belief,—as, for example, the facts: *First*, that quinine and arsenic, two substances which, although unlike in almost every other respect, resemble each other, as shown by the experiments of Dr. Binz of Bonn and Dr. Dougall of Glasgow, in being powerfully inimical to vegetable life, are in many cases our most reliable tonics. *Second*, that, as a general rule, three or four days must elapse before a decided invigorating effect is produced upon the system by these remedies,—a period which, we may conclude, is requisite for sufficiently impregnating the blood (without disturbing the digestive organs) to render it an unfavorable medium for the growth of Bacteria. *Third*, that after a continuance of some weeks these roborants generally lose their invigorating power upon any particular patient, but seem to have regained it if recommenced after their administration has been for a short time interrupted,—i.e. subsequent to the development of a new crop of Bacteria, which they again destroy. And *Fourth*, that arsenious acid has so remarkable an effect upon the arsenic-eaters of Styria, producing such fat, vigorous, and pure-complexioned individuals when steadily continued, and giving rise to such intense suffering if omitted for a short time; results which can hardly be owing to the arsenical preparation supplying any necessary constituent of the human body, and which seem much more probably to be due to some action in preventing a waste of nutriment, and consequently of vital power.

Dr. E. Richardson on Bacteria &

Theory



BACTERIA IN NORMAL BLOOD.—Dr. Kolaczek (*Centralblatt für Chirurgie*, No. 13, 1875) has repeatedly found Bacteria, such as are considered to be characteristic of certain diseases, in normal blood. Under a power of from one thousand to fifteen hundred diameters, certain diminutive round bodies are observed, having sharp contours, and somewhat refractive. They are sometimes arranged chain-fashion, usually two together, occasionally three, and maintain a rapid oscillatory and migratory motion, while the blood-corpuscles and their molecular derivations in the same field remain perfectly quiet. Two of the minute globules are sometimes joined together so as to look like a single one, and occasionally a couple of these double spheres join, to form a rectangular figure, possessing the above-mentioned peculiar movements.

Kolaczek's experience in the study of Bacteria leads him to class these globules as Bacteria or micrococci, and he therefore concludes that either Bacteria are found in all blood, or that, in spite of every precaution, certain of these minute bodies enter the preparations from the external air. He thinks that it is possible they may be introduced in the food, and has examined the excretions with great care, in order to see if they could be discovered in these.

The urine was examined by passing the stream, towards the end of its voidance, into a reagent-glass which had been cleaned with solution of potassa and sulphuric acid and boiled in absolute alcohol. From this it was immediately drawn by a tube prepared similarly, and of which the closed capillary end had just been broken open, while the other end was stuffed with cotton. It was then examined on a slide, and with a cover prepared in like manner. The result showed micrococci, which could no more have been imported from the air than those found in the blood. Dr. K. purposes undertaking further researches upon this subject.

X.

From Philo. Med. Times, April 24, 1875.



...compensating serous effusion.  
pia mater was somewhat cloudy, but not adherent to the dura. There was a slight serous effusion under it on the convexity of the brain. At the base and under the cerebellum, and between it and the medulla, there was slight but distinct extravasation of blood. On the surface of the left hemisphere there was an irregular spot, apparently the seat of a former clot, measuring three-fourths to one and three-fourths inches, to which the membranes were adherent, and which was depressed, soft, and of a yellowish hue. This area began above, at a point opposite the anterior central convolution, followed the course of the vertical branch of the fissure of Sylvius, and affected chiefly the upper part of the third frontal convolution, touching the extreme upper part of the second frontal convolution, and involving the lower anterior angle of the operculum. In the fissure of Sylvius the membranes were stained and adherent. The convolutions of the island of Reil were almost entirely effaced. The brain-substance immediately adjacent to the eroded island was not softened, neither was it stained with hæmatoidin.

---

## TRANSLATIONS.

---

DISCUSSION UPON THE EFFECTS OF NITRITE OF AMYL.  
—At a recent meeting of the Medico-Psychological Society of Berlin (*Wien. Med. Presse*, February 28), a discussion took place upon the effects of nitrite of amyl. Dr. Solger said that the flushing of the face produced by the inhalation of this remedy must be ascribed to a paralysis of the centres of innervation of the arteries supplying a certain area.

Other centres than those supplying the face are at times affected. He had himself experienced flushing of the hands and feet. He had used the nitrite in a case of unilateral clonic spasm in a child, without success. Chloroform used in the same case caused the



*Dr Satterthwaite of  
New York - 1875.*

THE MEDICAL

and disappeared with its fall, and again occurred during relapse. These observations have been confirmed by numbers of persons, though denied by Lapschinski.\*

This whole subject is so comparatively new that it is almost too early to look for records of further investigations on this point. The spirilla may indeed be pathognomonic of the blood of relapsing fever, but it is certainly a remarkable fact that Pontick, of Berlin (whose authority I feel, from personal acquaintance, to be of the best), should *not* have found them in the most marked lesions of the disease, for he tells us that the embolized and enlarged spleen is one of the chief causes of death,† and yet the emboli did not contain them, as we should have a right to expect. We must finally note that Klein, of London, has announced that in typhoid fever he has discovered peculiar bodies at or near Peyer's patches. These bodies were carried along the lymphatics or blood-vessels of the mucous membrane. Their bodies were often of a yellowish-brown color, and in size from one-fourth to three times the size of a human red blood-corpuscle. These bodies have not, so far as I have known, been seen by any one else.

There is one general fact that may be derived from the review of this question of contagious principles in small-pox, carbuncular diseases, relapsing fever, and typhoid—and this is, that we have no reliable evidence that the definite forms described are capable themselves of producing the diseases in question.

But assuming, as some would have us believe, that the diseases, if not produced by the filaments, chains, or heaps, are produced by minute forms that will produce such filaments, chains, or heaps, then our conclusions have to be derived from the effect of these granules by testing their physiological action, as has been shown by the use of vacuum tubes, and unless the granules in question respond to such tests as these, we have a right to doubt their being the germs of bacteria.

I have tabulated the following general conclusions, that appeared to be warranted by the investigations made in this direction :

1. Bacteria are certain vegetable organisms which belong probably to the algæ; they are found abundantly in nature, but chiefly where there is moisture.

2. They exist in the body in health, covering the mucous membranes from the mouth to the anus, and sometimes appear to penetrate a certain distance into the system, without causing symptoms of disease.

3. They also exist in putrefying fluids, and in various disease processes, occurring in hot and cold abscesses, in the blebs of erysipelas, and in simple blisters.

4. It is doubtful whether the virulent principle of infective diseases is albuminous.

5. This principle does not reside in the perfectly clear fluid that passes through porous clay. In putrid infectious fluids this appears to be certain. The poison is rendered less virulent by repeated filtrations through common filter-paper.

6. The virulent principle may be boiled for hours, filtered numbers of times in the ordinary way, boiled with alcohol, and again filtered and dried, and yet the watery extract of such a dry residue will produce septic symptoms. It is therefore soluble, or at least suspended in water.

7. The liquid which is thus poisonous may be clear to the eye, but contains granules under the microscope.

\* Centralblatt, 3, 1875. Irish Hosp. Gaz., April 1, 1875.

† Anatom. studien ueber den Typhus recurrens. Virchow's Archiv, May, 1874.

*Satterthwaite, 1875 -*



1. The patient is enjoined to abstain, as far as possible, from all albuminoid foods, and a milk diet is prescribed.

2. To promote the cutaneous functions hot-air baths are advised, followed by a cold douche, and afterwards moderate exercise.

3. As adjuncts to the above measures large doses of iodide of potassium and inhalations of oxygen are recommended. The ferruginous preparations are esteemed useless, for the reason that they are not assimilated.—*Le Progrès Médical*, Oct. 2, 1875.

**SUCCESSFUL TREATMENT OF ACUTE TRAUMATIC SUPPURATIVE INFLAMMATION OF THE KNEE-JOINT.**—From the *Schweiz. Corr. Bl.* of 1874, Dr. Asché quotes brief histories of three cases illustrative of the treatment of acute suppurative inflammation of the knee-joint of traumatic origin. The first case, reported by Prof. Socin, of Basle, concerned a butcher of twenty-four, who four days before had wounded his left knee with a sharp knife, laying open the joint. After binding the knee with a wet cloth he went on with his work, and at night walked home. When seen by S. the temperature was just short of 104° F., the knee was partly flexed, and at about an inch from the inner border of the patella was a sharply cut wound about one-fifth inch long, from which thin fluid escaped on pressure. There was fluctuation in the joint. The limb was put up in plaster-of-Paris in an extended position. The fever increasing after three days, the wound was dilated and an incision made along the outer border of the patella, and a drainage tube carried through it; at the same time extension up to thirty-five lbs., and counter-extension up to fifteen lbs., were applied. At the end of twelve hours the temperature had fallen to 100° F. Other incisions were subsequently made into the joint, but the tube and extension apparatus were removed after eighteen days. At the end of two months and a half after the receipt of the injury the patient could extend his leg vigorously, and flex it up to 80°. In the second case a carpenter of twenty-five had inflicted a wound with an axe on his left knee, and had continued working for some days. When seen by Dr. Sterchi, at the end of seven days, there was a wound of an inch long at the inner border of the patella, from which pus and synovia escaped; the joint was painful; no bare bone could be detected; the fever was moderate. An extension bandage and carbolic-acid dressing were applied, and recovery ensued. It should be observed that this patient was not treated in an hospital. A third case was that of a butcher, wounded in the knee with an axe. Suppuration set in, and an incision was made under carbolic acid into the distended capsule of the joint. Recovery followed under the use of carbolic-acid dressing. Thus it appears, says the commentator, that in individual cases the antiseptic treatment of suppuration of the knee-joint may be of service, although as a rule it is not possible in this way to prevent destructive suppuration of large joints when suppuration is already present. Permanent extension can produce a diminution of the intra-articular pressure only in cases where the ligaments of the joint and the muscles of the limb are much relaxed, taking off the pressure from the granulations and fluids in cases where the joint is closed, and when it is opened favoring suppuration and the escape of secretions. Still further advantages are found in preventing motion, improving the position of the limb, and changing the points of contact of the cartilages, and in preventing infiltration of the soft parts. Puncture of the joint should precede extension.—*Schmidt's Jahrb.*, Sept. 8, 1875.



---

8. These granules have not produced bacteria in a number of instances when they were placed in a suitable condition to do so.

9. We cannot, therefore, feel that satisfactory evidence has been brought to show that in any of the diseases or processes enumerated, minute organisms are the sole and sufficient causes of disease.

---



---

writers adopt the view that the muscular atrophy which follows traumatic lesions of the nerves is due to the diminution or suppression of a trophic influence derived from the nervous centres and conveyed to the muscles, not by the special trophic nerves of Samuel, but by the musculo-motor nerves themselves. Hence in the above case it is supposed that in consequence of a contusion or laceration of filaments of the musculo-cutaneous and anterior tibial branches of the sciatic, a

... .. the spinal root of the



CONTAGION AND PUTRIDITY.—A. Hiller (*Centralblatt f. Med. Wissen.*, No. 49, 1875), believing that investigators into the influence of vegetable organisms upon the production of contagious diseases have never properly isolated these organisms in their experiments, has undertaken certain investigations, the results of which go to show that these organisms are not in themselves the originators of disease, but probably either the carriers only, or the

teen and a half inches in width and nine inches in length from the rounded extremity to its junction with the belly-wall. The hernia is entirely reducible, and, by invaginating the sac, it is possible to pass two fingers through the ring into the abdominal cavity.

Although the contents of the tumor can be returned to the abdomen while the patient is recumbent, yet as soon as she coughs or rises to the erect position the intestines are protruded into the large



Feb. 5, 1876]

MEDICAL

exciters and reproducers of the latter. Cleansing bacteria of all forms, isolating them in distilled water, and then introducing them into the organism in various ways, Hiller has failed to produce septic infection. He therefore denies to these organisms all independent mechanical parasitic action, as well as the possibility of reproduction in living and healthy tissues, the blood in particular. He admits that their small size and ubiquity fit them to be the frequent and even constant accompaniment of accidental traumatic diseases, and that they may imbibe and carry septic poisons, causing local manifestations of various kinds. In the second part of his paper Hiller details certain experiments in the injection of small quantities of active bacteria from putrid solutions into fresh eggs, the result showing no appearance of putridity in the latter, even after some days. Hiller concludes from this that bacteria are incapable in themselves of bringing about tissue-change in albumen or of assimilating it in an unchanged condition. He believes, however, that there exist in the dust of the atmosphere, besides bacteria and animate germs, certain other inanimate organic matters which cause putrefactive fermentation, whether they are cellular (physiological) ferments or the proteic substances concerned in decomposition of which Liebig has spoken. From the fact that dust collected in a chamber and made into an infusion with recently-boiled distilled water showed signs of putrefactive change (bacteria, etc.) in a few days, H. concludes that atmospheric dust must hold actual putrescible substances.

Septic - see further on -

upon animals, that this complication should be looked for in cases in which, without apparent cause, there occurs, during the first few days, a rapid increase in severity of symptoms due to disturbance of the circulation in the lungs, and secondarily in the capillary portion of the greater circulation. That death was really due to this cause can only be certainly stated when at the post-mortem examination there are found changes in important organs of sufficient extent. These cases are especially those in which shock is given by English authors as the cause of death; but from deaths belonging to this category must be taken all those in which there is an interval of comfort of several hours' duration between the occurrence of the injury and the fatal termination. It is possible, also, that some deaths which have been ascribed to traumatic delirium or to commotio cerebri were really due to fatty embolism. To account for the occurrence of this, it is necessary to have fluid fat in a free state, as is met with when a bone is crushed and its cavity opened, and to suppose that this fat is forced, either by arterial pressure or by muscular action, into veins which have been torn. It can be readily understood that these conditions are fortunately not often present, but fatty embolism of a light degree may occur with nearly every fracture, and not cause any untoward results.

W. A.

THREE CASES OF SCLEREMA (Drs. Bernhardt and Schwabach: *Berliner Klin. Wochenschrift*, No. 47, 1875).—Two of these patients were females, while the third was a male; and this agrees with previous observations that the female sex furnishes



*The Relations of Micrococci to Erysipelas.*—According to Dr. W. LUKOMSKI, the microscopical examination of the skin of an erysipelatous region showed that where the process was beginning or extending the lymphatics were always filled with numerous micrococci, but where it was stationary or retrograding these organisms were absent. In one case, in which the erysipelas was extending downwards, the upper edge of the wound contained no micrococci, while there were abundance of them in its lower edge. Lukomski endeavoured to produce erysipelas experimentally in animals, either by the injection of fluids containing bacteria under their skins or by bringing putrid matter containing bacteria in simple contact with a healthy wound. In the first case, in which the fluids though containing bacteria were not putrid, rapidly spreading phlegmonous inflammation was set up in the subcutaneous tissues and in the cutis itself, and it was found that the micrococci rapidly multiplied and diffused themselves into the neighbouring lymphatics. Where infection took place through an open wound, inflammation followed, which exactly resembled erysipelas in man. The lymphatics were invaded by the micrococci just as in the other experiments, and they were always found most numerous at the edge of the inflamed skin where the process was still extending. The direction in which erysipelas spreads seems to be determined partly by the course of the

I. Dietetics and Regimen in Acute Fevers.  
II. Inflammatory States. III. The Diet and  
IV. Rheumatism. V. Gravel, Stone, Albumi-  
VI. nation. VII. Nerve Disorders. VIII. Scro-  
IX. diseases of Heart and Arteries.

excellence, and should, as it doubtless will, speed-  
ily find a place on the table of every physician.  
—*The N. Y. Sanitarian*, June, 1875.

Part I., on General Dietetics, and Part II., on  
Special Dietetics of Health, are particularly to  
be recommended to the intelligent reader who  
values his own health and that of his kin. They  
give so much sound information, frequently illus-  
trated by familiar examples, and so much advice  
under the most varied circumstances, that per-  
haps nobody will lay it aside without discovering  
some plain truth frequently disregarded or good  
reasons for acknowledged facts. To sum up our  
opinion of this work, we must say that we re-  
gard it as one of the most valuable additions to  
our literature on sanitary science, adapted not  
only to the special knowledge of the physician,  
but to the comprehension of every intelligent  
reader.—*Am. Journ. of Pharmacy*, June, 1875.

D—Just Issued.

DIETETICS, PHYSIOLOGICALLY  
ORDERED. By F. W. PAVY, M.D., F.R.S.,  
Physician at Guy's Hospital. In one very neat  
pages: cloth, \$4 75.

ity on the subject of which it treats, and which  
we have great pleasure in recommending to the  
attentive study of our readers.—*Dublin Journ.*  
*of Med. Sci.*, Oct. 1874.

The author has treated the subject in a large  
and attractive manner. While it is scientific,  
it is essentially practical. It fills a void in the  
literature of medicine for which every intelli-  
gent physician will feel grateful. It is hand-  
somely produced in all the details of printing,  
paper, composition, and binding. It is, in  
every sense of the word, a most valuable con-  
tribution to practical literature.—*Am. Journ. of*  
*Syphilography*, July, 1874.

We can very cordially commend the book to  
our readers.—*Brit. and For. Med.-Chir. Rev.*,  
Oct. 1874.

A, Philadelphia.



connective-tissue fibres, partly by the lymphatic vessels, and partly by the influence of gravity, by which the infecting substance tends towards the lowest point. Dr. Lukomski has been led by his experiments to form a decided opinion in favour of a connection between erysipelas in the skin and the immigration of low organisms into it, and he believes that the extension of the inflammation depends on their previous development in the tissues, since the micrococci can be detected outside the inflamed parts. He has been unable to determine whether they are carried from the surface by their own movements, or by means of wandering cells, or in some other way into the lymphatic vessels, nor can he explain their disappearance as the inflammation subsides.—*Med. Times and Gazette*, June 12th, from *Virchow's Archiv*.

---

CHAMBERS ON DIET AND  
A MANUAL OF DIET IN

By THOMAS KING CHAMBERLAIN  
Honorary Physician to H. R. H. the Prince of Wales  
and the Lock Hospitals; Lecturer  
Corresponding Fellow of the Royal Society

*In one handsome 8vo.*

The aims of this handbook are purely practical, and the right to increase its size by the addition of the latest information which rapidly collects round the nucleus has been thus gained for a full discussion of the subject. Space has been thus gained for a full discussion of the subject, which will drink with the daily current of social life, which every physician has led him to believe highly important.  
(Preface.)

TABLE OF CONTENTS

PART I. *General Dietetics.* CHAP. I. Theoretical Dietetics. II. On the Preparation of Food. IV. On the Influence of Food on the Health.

PART II. *Special Dietetics of Health.* CHAP. I. Regimen of Childhood and Youth. III. Regimen of Professional Life. V. Noxious Trades. VI. Affecting Travellers. VIII. Effects of Climate. IX. Effects of the Decline of Life. XI. Alcohol.

PART III. *Dietetics in Sickness.* CHAP. I. The Diet and Regimen of certain other diseases. II. Regimen of Weak Digestion. IV. Gout and Rheumatism, and Diabetes. VI. Deficient Evacuation, Dropsy, Rickets, and Consumption. IX. Diseases of the Small Intestine.